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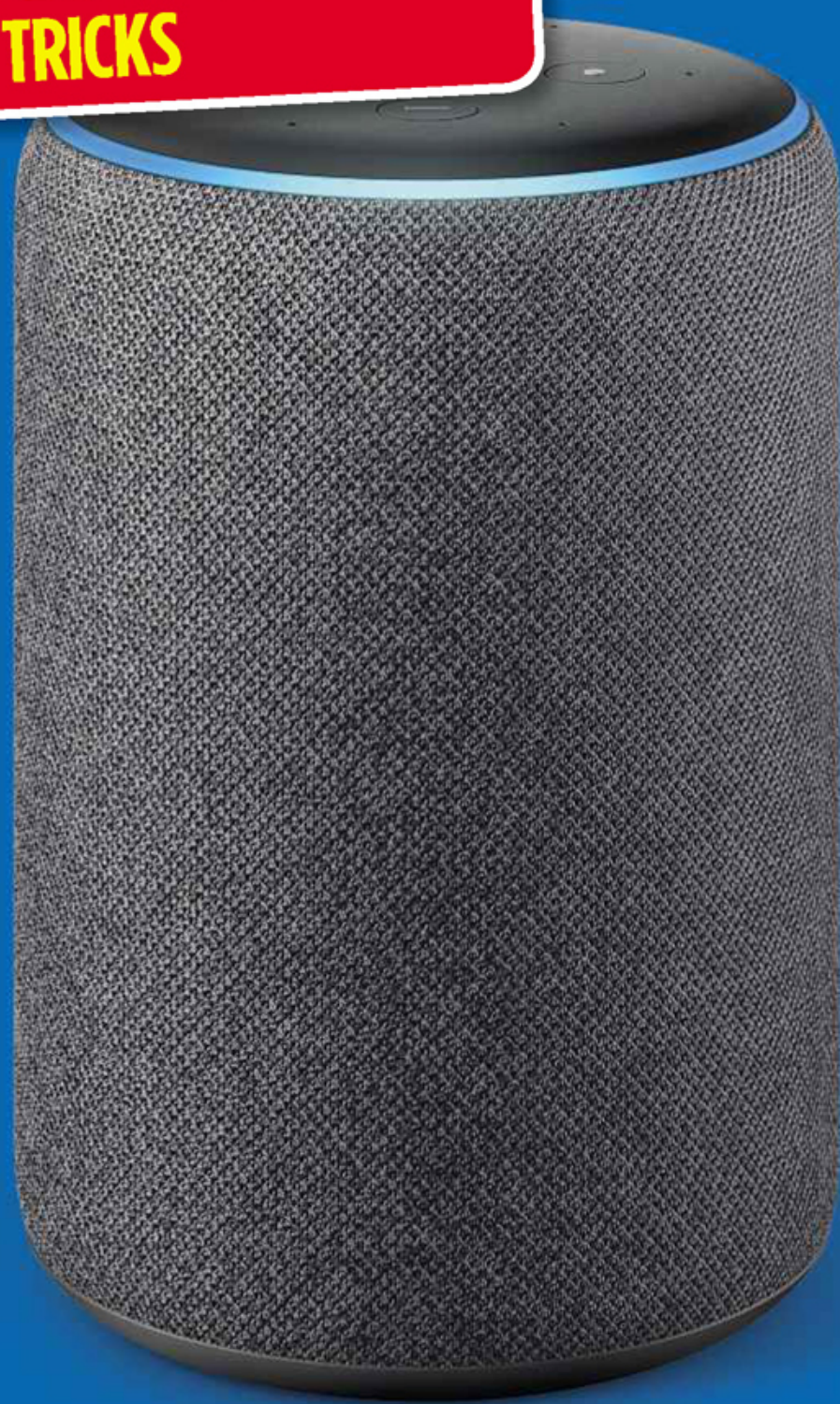
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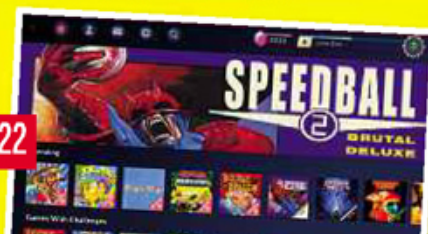
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## Contact us

**Editor** Madeline Bennett [madeline@computershopper.co.uk](mailto:madeline@computershopper.co.uk)  
**Reviews Editor** James Archer [james@computershopper.co.uk](mailto:james@computershopper.co.uk)  
**Contributing Editor** David Ludlow [david@computershopper.co.uk](mailto:david@computershopper.co.uk)  
**News Editor** Roland Moore-Colyer [roland@computershopper.co.uk](mailto:roland@computershopper.co.uk)  
**Senior Staff Writer** Nathan Spendelow [nathan@computershopper.co.uk](mailto:nathan@computershopper.co.uk)

### DESIGN & PRODUCTION

**Design** Bill Bagnall  
**Production Editor** Steve Haines  
**Production Manager** Daniel Stark  
**Production Assistant** Lewis Small  
**Network Production Manager** Kerry Lambird

### CONTRIBUTORS

Mike Bedford, Jonathan Bray, Tom Bruce, David Crookes,  
 Mel Croucher, Amy Davies, Kay Ewbank, Simon Handby,  
 Alan Martin, Christopher Minasians, Clive Webster

### ADVERTISING

Email [ads.shopper@dennis.co.uk](mailto:ads.shopper@dennis.co.uk)  
**Group Advertising Manager** Charlotte Milligan  
 020 3890 3486

### COVER GIFT CONTACT

Chris Wiles [support@creativemark.co.uk](mailto:support@creativemark.co.uk)

### SUBSCRIPTIONS

Tel: 0330 333 9493  
 Email: [customercare@subscribe.computershopper.co.uk](mailto:customercare@subscribe.computershopper.co.uk)  
 Web: [ManageMyMags.co.uk](http://ManageMyMags.co.uk)  
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### PHOTOGRAPHY

Michael Pheasant

### LICENSING AND SYNDICATION

Ryan Chambers 020 3890 4027 [Ryan\\_Chambers@dennis.co.uk](mailto:Ryan_Chambers@dennis.co.uk)  
 Anj Dosaj-Halai 020 3890 3816 [anj\\_halai@dennis.co.uk](mailto:anj_halai@dennis.co.uk)

### MANAGEMENT

Tel 020 3890 3890  
**Managing Director** John Garewal  
**Group Advertising Director** Julian Lloyd-Evans  
**Newstrade Director** David Barker  
**Group CFO/COO** Brett Reynolds  
**Chief Executive** James Tye  
**Company Founder** Felix Dennis

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“Alexa, turn on lounge light.” Mmm, that’s not it.  
 “Alexa, turn on living room light.” Nope, not that either.

“Alexa, turn living room light on.” Nothing.

“Alexa, turn – actually don’t bother, I’ll just get up and do it myself.”

For anyone who has used some kind of artificial intelligence-powered voice assistant, whether Amazon Alexa, Google Assistant or Siri, this probably sounds familiar. These AI systems promise us an easy life of bossing around an unseen slave, there to do our bidding, from turning up the heating on a cold night to turning down the volume of a tune when the phone rings.

But in reality, I often end up carrying out the task myself, as I can’t remember the exact wording required to get my assistant to do it for me. So there’s no point repeatedly shouting “Alexa, stop music” or “Alexa, stop Sonos” if the chosen command is ‘Alexa, stop’. She’s not smart enough – yet – to work out the nuances of our language.

To make the voice assistant experience a bit smoother, David Ludlow has spent hours testing out the various systems, and has put together a guide to getting the best out of Amazon Alexa. Turn to page 78 for advice on choosing the right Echo speaker, and step-by-step guides to linking your speakers for better music control and changing the wake-up word. Just think, no more Alexa interrupting your viewing every time the Lexus ad comes on TV.

I’m also pleased to announce that *Computer Shopper* is officially government-approved, kind of. Congratulations to our very own Clive Webster – tech expert, *Advanced Projects* editor and now newly elected UK councillor. Clive was elected in May’s local elections, no doubt aided by some excellent Excel-based campaign research (*Shopper* 376) and Quire-based team working (*Shopper* 368).

*Madeline*

**Madeline Bennett, Editor**  
[madeline@computershopper.co.uk](mailto:madeline@computershopper.co.uk)

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**0330 333 9493**  
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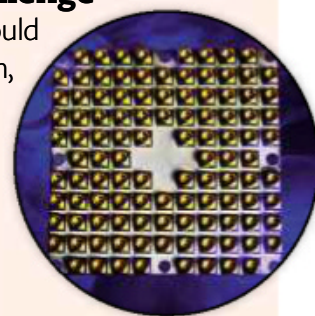


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6 FULL PACKAGES

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# Letters

Questions, questions. Are cloud-based password managers safe? What product did we recommend three years ago? And was Mel's last column his best one yet?

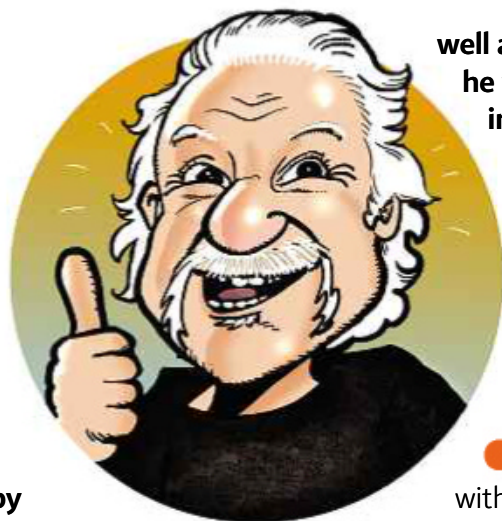
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## Mel-ifuious

**@** Can I use your letters page to thank Mel Croucher? I have been a fan of his work since the first PiMan.

In fact, I was very nearly involved with a later PiMan episode on the Spectrum through a mutual college friend, who asked me to investigate copy protection for a later release, but nothing ever came of it for me.

But Mel's article 'The great digital divide' (Mel's World, Shopper 377), I believe, was one of the best articles he has ever written. As



well as agreeing with everything he wrote, I found the article incredibly moving.

I have grown up – and old – reading Mel's work, and I have to say the old man still has it. Mel, please don't stop what you are doing.

Mark Painter

● We wholeheartedly agree with you – that particular article also struck a chord here at Shopper

HQ, and highlights the importance of us technology experts and enthusiasts to think about supporting the less tech-savvy, as the world continues its march to digital.

Mel is a true Shopper treasure and will hopefully be writing for us right until the very last issue of the magazine – which, all being well, is many years away yet!

## Combined harvester

**@** Some months ago, in the audio category of the Best Buy section of Computer Shopper, a regular recommendation was for a combined CD player with other things: MP3 player? Bluetooth speaker? Radio? It cost about £300 and was some kind of flattened oval shape.

As you can tell, I didn't pay much attention to it but, that has changed. Worse, I have not kept any of my back issues so cannot refer to them.

## ★ Star letter

### Pass on by

**@** I'm puzzled by your repeated recommendation of cloud-based password managers, most recently LastPass ('Use a password manager', Advanced Projects, Shopper 377).

Surely the passwords and other sensitive information which these services gather in the cloud, usually a whole collection of data for each user, represent the most irresistible sort of honeypot on the internet, and therefore will be the subject of hackers' most strenuous efforts?

I'm sure LastPass and others stress how secure they keep the data, but we've heard that again and again from the best-resourced tech companies, to no effect.

Perhaps I'm missing something, but for this reason I have avoided all such cloud-based password services.

I rely on some old software, which doesn't touch the internet and puts my passwords behind a master password. This gives me a file, which I can copy from device to device for manual syncing. I know it's old software and therefore wouldn't stand up to serious attacks for long, but it's on nobody's radar any more

and I don't write my passwords in plain text within it anyway. I feel pretty secure with this method of storage.

Do you know of any currently supported password manager software, which doesn't use the cloud and, better still, allows some direct syncing between devices?

More generally on this theme, how about a series of articles for us cloud-refuseniks, such as managing PIM data across devices? Syncing directly between, say, Windows and Android, in a way that doesn't rely on one device manufacturer's here-today-gone-tomorrow software, can be quite tricky.

Mark Adams



● LastPass encrypts passwords on your device before sending the data to the cloud. Without your

password, even LastPass can't read your data. If the service was hacked, then only your encrypted data would be lost.

The bigger risk is using a weak password for LastPass, but a long password and two-factor authentication helps keep you safe. The flexibility of cloud sync across multiple devices more than makes up for the potential security threat in our mind.

To protect your passwords offline, an old-fashioned book with long passwords written in it is a good bet – just don't lose it.

### » Write in and win

Do you wish your computer was faster when booting and loading applications? Thanks to Crucial, you can achieve your dream of a faster PC or laptop with a 500GB MX500 SSD. The writer of our Star Letter will be awarded one of these solid-state devices, which can be installed in a desktop PC or a laptop.

This SSD is 45 times more energy efficient than a typical hard drive and has sequential reads/writes up to 560/510MB/s and random reads/writes up to 95K/90K IOPS, making it the perfect replacement for the ageing hard drive in your sluggish PC.



**STAR PRIZE**  
500GB  
SSD





Is there any way you can point me in the right direction as to what this item is/was? I might be in the market for one.

For your interest, the monthly arrival of *Computer Shopper* on the doormat is always welcome. While I may not always need to purchase new ‘gizmos’ and can therefore read the reviews with just general interest, I do appreciate the more technical articles looking at the wider aspects of computing, the internet, legal aspects and so on.

John Letton

It was the Panasonic SC-All7CD (*Shopper* 346). If you happen to live in the Southwest, you can get it for £199 at Woolacotts, or there’s a lower-specced Panasonic SCRS52EBK model on sale at Amazon, although you won’t be able to connect to other smart speakers. Otherwise, it’s around £300 from various online sites, including Electrical Discount UK.

Divide and rule

@ Steve Webb wrote in to say that he would like a ‘bang for buck’ comparison of CPUs and other components (*Letters, Shopper 377*). He demonstrated how he achieved this by dividing the benchmark numbers by the price of the CPU to give a

reference number – which by the green highlight in the screenshot below suggests that the lower the number, the better.

However, for this to be the case, you have to do the division the other way around, in other words, divide the price by the benchmark numbers. This way, it gives you a result in the amount of pounds you have to pay to get an extra number on the benchmark score.

Simon P

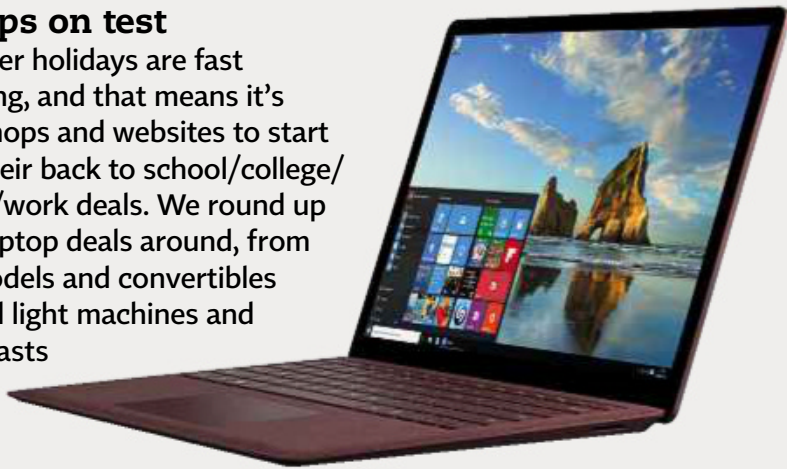
Both are valid comparisons, but we have a slight preference for dividing the benchmark by price to give the result as points per pound. Under this example, the bigger the number, the better the deal. For example, a CPU that scores 100 in our benchmarks and costs £80 returns a result of 1.25 per pound spent. A CPU that scored the same but costs £160 returns a result of 0.625 per pound spent.

Zoom level. Click to open the Zoom dialog box.									
	A	B	C	D	E	F	G	H	
1		Benchmark Results				Bang for buck			
2	CPU	Overall	Video	Multitasking	Price	Overall	Video	Multitasking	
3	Core i9-9900K	330	319	390	475	0.69	0.67	0.82	
4	Core i7-9700	267	258	304	390	0.68	0.66	0.78	
5	Ryzen 7 2700K	231	226	262	295	0.78	0.77	0.89	
6	Ryzen 5 2600X	206	201	229	185	1.11	1.09	1.24	
7	Core i3-8100	112	113	114	108	1.04	1.05	1.06	
8	Ryzen 3 2200G	100	103	98	82	1.22	1.26	1.20	
9									
10									

In the next issue

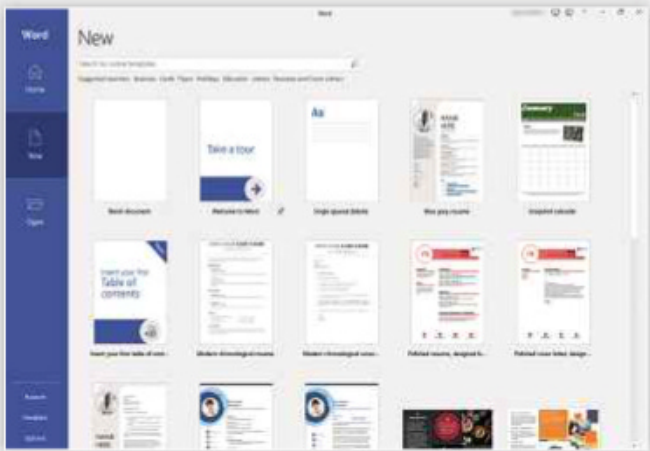
Laptops on test

The summer holidays are fast approaching, and that means it’s time for shops and websites to start offering their back to school/college/university/work deals. We round up the best laptop deals around, from budget models and convertibles to thin and light machines and gaming beasts



Use Word like a pro

Microsoft’s word-processing application might be widely used, but is it well used? We show you some power-user tricks



Happy half-century, Unix!

We all use Unix every day, when we browse the web or use our mobile phones. So how did what began as an underfunded attempt to build a simple OS to run a phone network become one of the greatest influences on modern life?

Cerebral computation

We investigate research into an alternative model of computation, which offers the potential of massive performance gains by mimicking the human brain



COMPUTER SHOPPER ISSUE 379 ON SALE IN NEWSAGENTS FROM 11th JULY



# Vice control

Frustrated by the modern virtuous voice assistants who refuse to cuss and curse, **Mel Croucher** takes matters into his own grubby hands by teaching Siri to swear



## MEL CROUCHER

Tech pioneer and all-round good egg  
letters@computershopper.co.uk

**WHEN I WAS** a boy, my Uncle Sid had his voice box removed, thanks to a pioneering navy surgeon and a 40-a-day cigarette habit. Uncle Sid's was the first synthetic voice I ever heard. It was generated by a battery-driven unit that looked a bit like an electric shaver, and he pressed it to his throat when he needed to communicate. The device emitted a very scary monotone, which was a cross between a Dalek and a vacuum cleaner, and Uncle Sid would cough after every word. His favourite word was 'pfah!'

For years, all synthetic voices sounded like Uncle Sid, from homicidal computers in sci-fi movies to Stephen Hawking. So in 1983, when I got hold of my own artificial voice box, I knew what to expect. It was a black plastic unit the size of one of Uncle Sid's fag packets called a Currah Speech Emulator, it worked on a Sinclair ZX Spectrum, and it cost me £30.

Like every other purchaser, the first thing I did was to teach it to swear, and sure enough it sounded just like Uncle Sid saying 'pfah', cough! That same year, I

sounded very much like Theresa May, only a lot more human.

## DRONE ON THE PHONE

It won't come as a surprise if I tell you that Uncle Sid wasn't very good on the phone. But his widow was. Auntie Ollie could bore the pants off anyone who had the misfortune to be on the other end of her calls, and when synthetic voices were introduced for automated telephone responses it didn't make the slightest bit of difference to her.

Auntie Ollie would happily conduct lengthy conversations with tape recordings and automatons, and she would even argue with the Speaking Clock when British Summer Time kicked in. As for the repeated warning to 'mind the gap' on the platform of Embankment Tube station, she would yell Uncle Sid's favourite phrase at it, then tell it to 'change the record' without any hint of irony.

I have no idea what Sid and Ollie would have made of modern ubiquitous chatbots, but I expect they would have welcomed the company. Personally, I can't stand their long-suffering politeness, and the default setting of their synthetic accents is pathetic.

I suspect Professor Stephen Hawking originally had a melodious Geordie lilt, and nobody ever bothered to tell him that his computerised voice was a practical joke and he didn't have to sound like Uncle Sid after all. As for Alexa's default accent, if I really wanted to have an American in my house, I'd hire Stormy Daniels like any other hypocritical narcissistic despot.

Of course, today's smart speakers and personal digital assistants can be programmed in any combination of languages, accents, moods and pitches. When it comes to my own favourite vocal synths, I am having a simultaneous relationship with Australian Siri and Irish Siri, and I can't decide

which one I prefer. Australian Siri has a languid drawl with spontaneous hints of dominatrix, whereas Irish Siri is jollier but has an unfortunate tendency to yodel.

## BUM NOTES

Whatever programmed choice I have, we live in different times from when Uncle Sid would utter profanities through his squawk-box, or when I forced my Currah Speech Emulator to talk dirty.

Siri lives in my pocket, cheek by jowl to my reproductive organs, but when I invite her to swear she goes all Mary Poppins on me. Either that or she exhibits her disgust by refusing to respond altogether.

Her brothers and sisters are the same. You know the ones I mean: Alexa, Watson, Cortana, Viv, Bixby, Alice and all those other virtual assistants, who seem to have been programmed by nuns. Perhaps the mother superior misheard and ordered the creation of virtuous assistants.

Well, sod that. Obviously, I have nothing better to do with my life than make artificial intelligence speech modules emit obscenities, so I have a few tricks up my filth-encrusted sleeve. I can play a game of Simon Says with Alexa, and the deluded automaton will repeat my depravities verbatim. A simple pleasure, but a fulfilling one.

For Siri or Cortana, I speak the command 'change my name'. When the prissy killjoy responds by asking what my new name is, I say something like 'hello'. Then she invites me to 'tap to edit', and my trap is sprung. I delete my innocent 'hello' and type in a stream of utter filth, such as 'bum pooh plippy plops'. Hey presto! Siri will now greet me with this term of endearment whenever I open a conversation.

Truly, this is what modern technology is all about. Or as Uncle Sid would have said to today's synthetic voice machines, 'pfah' cough! 🐔

As for Alexa, if I really wanted to have an American in my house, I'd hire Stormy Daniels like any other hypocritical narcissistic despot

began driving an Austin Maestro, which boasted a solid-state electronic dashboard equipped with a synthetic voice. Its vocabulary consisted of 36 words, all of which were selectively combined to moan at me for not wearing a seatbelt, or running out of petrol, or swearing.

The car's artificial voice was sampled from a New Zealand actress called Nicolette McKenzie, who later played a character called Bea in the pitiful videogame Leisure Suit Larry: Wet Dreams Don't Dry, and I distinctly remember that it



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# It's a lockout

Channelling the spirit of Dusty Bin, **Kay Ewbank** offers her 3-2-1 guide to backing up, so you won't be left feeling frustrated if you're locked out of your iPad for 48 years



**KAY EWBank**

Software guru and Shopper legend  
letters@computershopper.co.uk

**A WRITER AT** *The New Yorker* recently posted a tweet that said:

"Uh, this looks fake but, alas, it's our iPad today after 3-year-old tried (repeatedly) to unlock. Ideas?"

The tweet had an image attached of the iPad's screen saying the device is disabled, along with the message, "Try again in 25,536,442 minutes."

To save you doing the arithmetic, that's over 48 years. Quite a while to be waiting to get back to your music, photos and documents.

What had happened was the toddler had kept trying to unlock the device by typing the wrong password, and Apple devices have a security feature under which the more times an incorrect password is entered, the more time is added to the lockout time. Persistent toddler, 48-year lockout.

Apple's advice in these circumstances is to carry out a restore operation, but that would lose any data on the device that hadn't been backed up.

It's all too easy to read stories like this and think it's something that will never happen to you,

DVDs that have degraded. So what should you do?

The classic advice is that you should adopt a 3-2-1 strategy. This may bring up unfortunate images of Dusty Bin in the more mature readers, but what this says is:

3: Have three copies of your data.

2. The copies should be in at least two separate places.

1. At least one copy should be stored somewhere different to where your normal storage is, so if you keep all your photos at home, keep another copy at the office, in the cloud, at a friend's house – somewhere physically different.

## ONE FOR THE MONEY

Step one, then, is to have multiple copies of files that matter. This doesn't mean taking a copy of every email about recycling and every pic your Auntie Ethel sends you of her cats, but if there's something you'd be devastated to lose, copy it. Put a copy on at least two machines; your PC and

another machine. If you're really cautious, you might want to put your precious files on to a drive that's kept somewhere else; what if your house burns down or you get burgled? The key to this strategy is to put an automatic reminder in your online diary or calendar so you get nagged about it, otherwise your backup will go out of date faster than sushi in a heatwave.

## TWO FOR THE SHOW

Then comes the 'keep it somewhere else' part. You don't need to be too precious about this. We're increasingly offered automatic cloud-based backup, especially from smartphones, and if you aren't, look for them. Things that work automatically have a lot going for them, because they still happen when you're busy or think it's not worth doing this week.

Services such as Apple iCloud, Dropbox, Microsoft OneDrive or Google Drive keep the files on your computer synchronised with their cloud-based copy, whether you remember or not. It means you can get at your documents from any machine that has internet access, including your phone – so long as you've not been locked out by your toddler.

Lastly, and I know this may sound like I'm a Luddite, I have a final piece of advice. If there's something you really cherish, then take a physical copy: print out that email and file it, get a print of the photo you'd cry about losing and put it in an album. If you think I'm being anti-tech, let me send you my 5.25in diskette, or my Zip drive disk, or the disk from my Apricot F1, or... I bet you'll struggle to find a drive and driver to read it, even if the disk or diskette hasn't given up the ghost. Technology moves on, and some day you'll want to look at something and it won't work. There's a lot to be said for a photo album. 📷

I have an impressive range of obsolete and failed backup devices and strategies; email accounts I no longer have access to; hard drives that don't work; DVDs that have degraded

but less drastic lockouts can happen to all of us. The best defence is knowing the photos, documents, emails and things that matter to you are available no matter what happens to your computer or phone.

I reckon I'm a real expert in this 'cos I've managed to make so many wrong choices over the years. I have an impressive range of obsolete and failed backup devices and strategies; email accounts I no longer have access to; hard drives that don't work;

your phone at the least, or an external memory stick or external disk drive.

I'm also a great fan of using an external disk drive for backup. Once a month I plug in my backup disk drive and copy anything recent that's important to it – photos, spreadsheets, documents. Then it goes and sits in a filing cabinet. That way, if my machine gets a virus, or crashes, or a random toddler locks me out for 48 years, I've still got the files accessible to put on to



Make It Yours.



## KEEP A LOW PROFILE.

### SK630, SK650

The **SK630** and **SK650** Mechanical Keyboards are slim keyboards with all of the signature **Cooler Master** features like on-the-fly controls and RGB backlighting – also adding new Cherry MX Low Profile Switches.

A reduced travel and actuation distance with extra-flat keycaps means that you get all of the precision and durability of a mechanical keyboard. All of this within a minimalistic slim stylish keyboard.

Add in a refined brushed aluminium housing and understated LED ring, and you have a keyboard that looks as good as it performs.





# RANTS & RAVES

Technology may be a long way from solving the Irish border issue or simplifying your VAT bill, but at least it's helping in the fight for animal conservation

Madeline Bennett

## RANTS



**FOR MANY YEARS** now, we've been hearing promises from our government (whichever one is in power) that technology is the answer to many of our problems. Everything from the Brexit-complicating Irish border question to easing the burden on the NHS can be solved by a sprinkle of computing magic, or so we're told.

Reality is very different. Technology already exists that could see doctors' waiting rooms emptied, thanks to online video consultations and wearable tech that transmits our data to medical professionals. Or better still, forgo the human element altogether and send this straight to an AI system, which can compare your results against millions of others with similar symptoms and deliver a diagnosis.

The trouble is, while technology is ready for this medical revolution, us humans aren't quite there yet. Many of us still prefer talking to a doctor in person, and we don't all relish the idea of devices collecting, storing and sharing our vital statistics.

Even where the government has managed to go digital, the results aren't always helpful. First, there's the problem of whole

groups of society being locked out of critical online-only services (see *Mel's World*, *Shopper 377*, for a vivid portrayal of the digital divide). And then there's the fact that government departments aren't always as joined-up as they like to think they are, as I was reminded when dealing with a VAT bill.

I recently received a letter from HMRC, warning me that if I didn't pay said bill within 14 days, I'd face a penalty.

My VAT account shows I'm in credit by roughly the same amount as the sum owed. I tried phoning the VAT helpline several times to confirm they could use this balance to pay my bill, but each time I managed to get as far as the security measures only to be told, "We're sorry, we can't deal with your call at the moment. Goodbye."

When I finally managed to speak to someone, he explained that although I had the right amount in credit to cover the bill, the system hadn't been updated. I'd need to phone the original number (which I can't get through to) to request a refund, and then repay the bill.

His other advice was to phone back in December, when the system should have updated. Yes, December. It's currently May.

So I've admitted defeat. As there's no way to speak to someone to request a refund, I've simply paid the lump sum again.

As to the chances of the Irish border issue being miraculously solved by government-run technology? About as likely as the government finding a deal equally loved by Leavers and Remainers, I'd say.

James Archer

## RAVES



**IF YOU'RE READING** this, you've hopefully also read Madeline Bennett's *Shopper 377* investigation into how conservationists are using technology to protect animals in the wild. It's heartening to know that drones and AI are being harnessed in ways that benefit wildlife, humanity and the planet all at once – certainly more so than yet another story of creepy surveillance practices on citizens.

I've recently stumbled on a similar tale of tech being used to help animals in captivity. Chengdu Research Base of Giant Panda Breeding, in China, has developed a facial-recognition system to keep track of its resident pandas. Their markings might make it difficult for a human to tell them apart, but with the AI-powered app, both scientists and visitors can instantly identify individual bears.

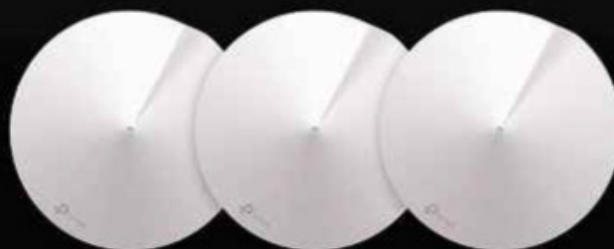
For tourists, this will allow them to view facts about each panda, but it's expected to help conservation efforts, too. A more reliable way of identifying each panda, without the need for more physically intrusive tracking measures, could help with anything from feeding schedules to the study of genetics. There are plans to use the same technology to study and manage pandas outside captivity as well.

This isn't the first attempt to develop humane, tech-based tools for identifying animals. Princeton University and the University of Illinois at Chicago previously created *StripeSpotter*. This open-source project converts photos of zebras into a set of black and white bands, with each set corresponding to the unique pattern of an individual zebra. In 2017, researchers developed similar facial recognition to that of Chengdu Research Base, but for lemurs: named *LemurFacelD*, the system allows scientists to track members of the endangered species in the wild without having to trap and tag them first.

The panda-based equivalent might not have a name out of a Silicon Valley startup, but it is another example of technology at its best: a just cause, enabled by pragmatic design. More like that, please.



# STREAMING WITHOUT LIMITS



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# NEED TO KNOW

The biggest stories from the tech world, and what they mean for you

## OnePlus 7 Pro takes the fight to flagship phones

### SAY WHAT?

**FROM HUMBLE BEGINNINGS**, OnePlus has built itself into a powerhouse in the smartphone market, with the handsets it has produced over the past couple of years snapping at the heels of flagship phones, yet coming at more wallet-friendly prices.

The OnePlus 5T, 6 and 6T all received critical acclaim for offering a suite of high-end features for a mid-range price. However, none of these phones could quite knock more expensive flagship handsets off their lofty perches.

But with the launch of the OnePlus 7 Pro, the Chinese company finally has premium smartphones such as the iPhone XS and Samsung Galaxy S10+ in its sights.

Taking the design cues of the 6T as a base, the 7 Pro features a 6.7in curved display, dubbed 'fluid AMOLED', with a quad HD resolution, a fast 90Hz refresh rate and compatibility with the HDR10+ standard.

But the screen's real party trick is that it pretty much fills the entire front of the phone, thanks to OnePlus making use of a motorised, pop-up, front-facing 16-megapixel camera. According to OnePlus, the mechanism can withstand at least 300,000 pop-ups, at a speed of 0.53 seconds, and thus should last for more than several years of use. The 7 Pro can also detect when the phone is falling or in a person's pocket, and will automatically retract the camera to protect it from damage.



Speaking of cameras, OnePlus has joined the triple rear-camera trend, with the 7 Pro using a 48-megapixel main lens with an aperture of f1.7, a 16-megapixel ultrawide lens with a 117° field of view, and an 8-megapixel telephoto lens with 3x optical and 10x digital zoom.

Seemingly drawing inspiration from Google's Pixel phones, the 7 Pro will take data from multiple photos shot at the same time and stitch them together for high-resolution images with a boosted dynamic range.

To power the camera, along with retaining OnePlus's reputation for delivering very fast phones, the 7 Pro uses Qualcomm's Snapdragon 855 system-on-a-chip, matched with up to 12GB of RAM, and storage that hits a healthy 256GB. This storage also hits the UFS 3.0 standard, which promises fast read and write speeds.

A 4,000mAh battery should keep the phone going for a day's worth of use, and access to OnePlus' Warp Charge technology will ensure the phone can be rapidly charged when power levels get low.

A suite of other improvements over the 6T help the phone earn its 'Pro' moniker, including a larger, faster optical fingerprint scanner, a boosted haptic feedback motor, Dolby Atmos-compatible stereo speakers and a 10-layer water cooling system. It also comes in a trio of fetching colours: Nebula Blue, Almond and Mirror Grey.

## Microsoft and Sony put rivalry aside in the cloud

### SAY WHAT?

**DESPITE BEING RIVALS** in the gaming world, Microsoft and Sony have entered into a partnership to work on cloud technology for game streaming and artificial intelligence (AI) services.

The companies have signed a memorandum of understanding, which will see them jointly work on future cloud services based on Microsoft's Azure infrastructure, with the goal of creating content and game-streaming services that offer "enhanced entertainment experiences".

The partnership is an odd one at first glance, given Microsoft's Xbox division is a direct rival to Sony's PlayStation business. Furthermore, Sony has its PlayStation Now game-streaming service and Microsoft is poised to launch its take on game streaming with xCloud.

But while the partnership could be one way for Microsoft to get more people using its globe-spanning cloud service, the tie-up looks to be more about developing cloud technologies, with Microsoft noting that it will involve "building better development platforms for the content creator community".

Sony's CEO Kenichiro Yoshida acknowledged the rivalry between the two companies, but painted the partnership as one that will be more focused on the exploration and creation of new technologies.

"For many years, Microsoft has been a key business partner for us, though of course the two companies have also been competing in some areas. I believe that our joint development

of future cloud solutions will contribute greatly to the advancement of interactive content," said Yoshida.

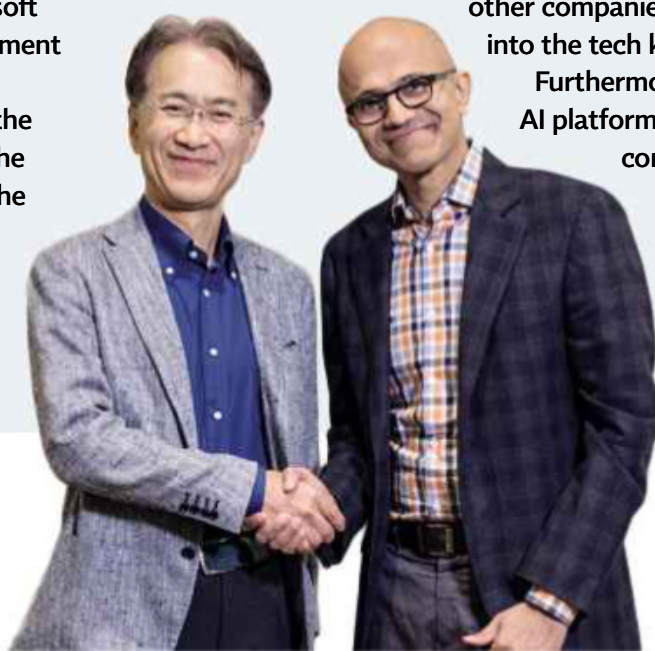
"Additionally, I hope that in the areas of semiconductors and AI, leveraging each company's cutting-edge technology in a mutually complementary way will lead to the creation of new value for society."

Speaking of semiconductors and AI, the partnership will see the joint development look at creating new intelligent image-sensor technology, tapping into Sony's work on sensors combined with Microsoft's Azure-based AI technology.

This proposed work will not only involve Microsoft and Sony creating semiconductors and services that can be incorporated into their own products and services, notably cloud and edge computing systems, but will also be aimed at making products for businesses. That could mean other companies could end up making smart systems that tap into the tech kicked out by this unexpected partnership.

Furthermore, the joint venture will explore how Microsoft's AI platform and tools can be integrated into Sony's consumer products to produce "highly intuitive and user-friendly AI experiences".

Both companies have been vague on details of what these experiences might look like, but they could mean more Sony products with cloud connectivity and AI technology, courtesy of Microsoft.





## SO WHAT?

**ALL IN ALL**, the OnePlus 7 Pro looks like a proper flagship smartphone, rather than one that has some of the features of high-end handsets but falls slightly short of being a true premium device.

We will have to reserve our full judgment until we have the phone in for review. However, as things stand, the 7 Pro looks like taking OnePlus in a direction that will see it directly compete with Apple, Samsung and Huawei in the premium phone arena.

That's an interesting position to be in, given those trio of hardware makers have arguably been driving a lot of smartphone innovation, meaning a true flagship phone really needs to bring something new to the table. The OnePlus 7 Pro's massive premium display is arguably one such feature – but it comes at a cost.

With a starting price of £649, the OnePlus 7 Pro is several hundred pounds below the £1,000 price mark that fully spec'd Apple, Samsung and Huawei phones have no qualms about sailing past. But £799 for a tricked-out

7 Pro is still well within the realms of flagship territory; there are some of us that remember high-end phones costing around £500.

We only hope that the move to compete with premium handsets doesn't see OnePlus lose its roots of providing its dedicated community of users with a phone packed with the features they want at a price that remains palatable.

There is a saving grace in the form of the OnePlus 7, effectively a OnePlus 6T with updated internals and the same 48-megapixel main camera lens as its Pro sibling. It also shares the same price as its predecessor, showing OnePlus is still creating impressively spec'd phones for decent prices.

Nevertheless, the debut of the 7 Pro is an indication that OnePlus is ready to grow from middle-of-the-road upstart into a full-blown premium phone maker. That means there are some exciting times ahead for the company and its followers, especially if it turns its hand to creating a foldable phone.

## SO WHAT?

**OUT OF NOWHERE** is the best way to describe this partnership. While Microsoft and Sony may have worked together in the past, they still remain staunch rivals in the gaming arena. And with xCloud set to debut this year and thus rival PlayStation Now, that rivalry isn't likely to dissipate.

Getting a game-streaming service off the ground is notoriously tricky. While Sony acquired the game streaming flop that was OnLive, it can't match

Microsoft in terms of cloud computing reach.

As such, tapping into Microsoft's cloud infrastructure could be one way for PlayStation Now to boost the performance of its service. For Microsoft, it means another big brand on its Azure cloud, but also a chance to learn from Sony's PlayStation division and use the Japanese giant's experience with PlayStation Now in order to finesse its game-streaming capabilities when xCloud launches.

“Our joint development of future cloud solutions will contribute greatly to the advancement of interactive content”

Sony CEO Kenichiro Yoshida

Given Google is entering the game-steaming arena with its Stadia cloud-powered service (see *Shopper 377*), both Microsoft and Sony could be facing a gaming upstart that has the

scale to challenge them. So sharing expertise and resources would make sense when it comes to fending off Google.

However, there's more to the partnership, notably the work on AI and image-sensor technology.

There's a chance that the next wave of Sony Xperia phones and Bravia TVs could come with Microsoft's Cortana virtual assistant built in, adding a new level of cloud-powered smarts to such gadgets.

With the combination of Sony's image-sensor hardware and Microsoft's cloud-based AI systems, we could envisage a DSLR with Wi-Fi connectivity, which can not only send photos to the cloud, but also apply AI-based image processing to shots.

## BOOTING UP

### Bendy laptops

Lenovo has jumped on the folding-screen trend, only rather than putting one in a phone, it has made a ThinkPad with a flexible display. Lenovo calls it the world's first foldable PC



### Gold at the end of the rainbow

The estate of Harold Arlen, composer of *Over the Rainbow*, is suing Apple, Google, Amazon and Microsoft after finding more than 6,000 unauthorised copies of Arlen's songs on their services

### Ethical AI

The government has appointed a host of experts to its artificial intelligence council, including Alan Turing Institute chief executive Professor Adrian Smith and Ocado CTO Paul Clarke, with the goal of ensuring ethical AI use

### HPE goes cray-cray

Hewlett Packard Enterprise has snapped up supercomputer firm Cray for \$1.3bn, with the goal of cranking out more high-performance computers. Expect to see new supercomputers with mind-boggling performance before too long



### Gummed up

The fingerprint scanner on the Nokia 9 PureView was fooled by pressing down on it using a packet of chewing gum.

The problem has now been patched, thus avoiding a sticky security situation

### Facial unrecognition

San Francisco has become the first city in the US to ban facial-recognition tech because of concerns about embedding bias in AI technology and society

### Haranguing Huawei

The US government has banned Huawei from buying American-made equipment without government approval as fears mount over the alleged risk the Chinese firm poses to national security

### Counting the cost

The 2017 security breach of credit report giant Equifax has cost the firm \$1.4bn thus far, making it one of the largest data breaches ever recorded

## CRASHING



## FROM THE LAB

# US military looks to artificial intelligence for close-combat aerial dogfights

**FUTURE AIR BATTLES** could be fought with the help of artificial intelligence (AI) systems, as the Defense Advanced Research Projects Agency (DARPA) is aiming to train AI technology to engage autonomously in close-range aerial duels.



avoiding fire from enemy jets. In doing so, pilots can apply their abilities to situations unfolding in a larger aerial battle, such as firing weapons and executing commands in the midst of combat.

The use of AI in this

At the moment, no AI system can outwit a human fighter-jet pilot in high-speed, high-G dogfights, despite machines being able to trounce humans in activities such as poker, computer gaming and the ancient Chinese board game, Go.

But DARPA's Air Combat Evolution (ACE) programme aims to change that by adding more AI-powered technology into fighter jets, which will work in collaboration with human pilots in dog-fighting scenarios.

"Being able to trust autonomy is critical as we move toward a future of warfare involving manned platforms fighting alongside unmanned systems," Lieutenant Colonel Dan Javorsek, ACE programme manager at DARPA's Strategic Technology Office, explained.

"We envision a future in which AI handles the split-second manoeuvring during within-visual-range dogfights, keeping pilots safer and more effective as they orchestrate large numbers of unmanned systems into a web of overwhelming combat effects."

By training AI in the rules of dogfighting in the same way new fighter pilots are taught, ACE hopes to have systems that can take care of things such as

fashion is part of DARPA's aim to create 'mosaic warfare', by which military combat is conducted by both human-controlled machines and AI-powered systems. This approach plans to have simple smart systems networked together, rather than having the military create a single autonomous advanced platform or war machine.

The idea is that if one part of such an AI-centric network is destroyed, the rest can still work as a whole and that expendable part can be replaced and, as such, make combat more lethal for the US's enemies while better for the military in terms of human and monetary costs.

"Linking together manned aircraft with significantly cheaper unmanned systems creates a 'mosaic' where the individual 'pieces' can easily be recomposed to create different effects or quickly replaced if destroyed, resulting in a more resilient warfighting capability," DARPA notes.

With the ACE programme, DARPA will start off training the AI systems in the basics of dogfighting under the watchful eye of instructors. Only when human pilots are confident in the AI development will such autonomous systems be put into more challenging scenarios.

## SOUND BYTES

**"If dogs could talk – and we cannot stress this enough – they would tell you to drive a Tesla"**

Elon Musk's car company isn't shy on self-promotion

**"Our inquiry has exposed a health service that is losing its grip on health screening programmes"**

Public Accounts Committee chair **Meg Hillier MP** on why some NHS technology is unfit for purpose

**"We want to empower everyone to use AI to apply to problems they see in their communities"**

Google's AI boss **Jeff Dean** talks up the societal benefits of AI tech

**"The stakes are too high in criminal investigations to rely on unreliable – or wrong – inputs"**

Georgetown University's Center on Privacy and Technology on the NYPD's alleged abuse of facial-recognition technology

**"Chopping a great American success story into bits isn't suddenly going to make those problems go away"**

Former Lib Dem leader turned Facebook global affairs chief **Nick Clegg** isn't convinced that breaking up the social network will solve its privacy problems

# Google's Pixel 3a software wizardry paints a powerful picture for future phone cameras

**TAKING THE STELLAR** camera of Pixel phones and popping it into the mid-range, well-priced Pixel 3a and 3a XL phones has been a sharp move by Google, as our review later on in the issue will explain (see page 48).

While the camera in the new Pixel phones is near-identical to that of their flagship siblings, Google had to make one major cut; it removed the Pixel Visual Core image signal-processing chip.

Yet despite this omission, the Pixel 3a phones take some of the best photos around, albeit a touch slower than their high-end kin.

That's all thanks to Google really pushing its software engineering and optimisation to ensure that the lack of hardware processing doesn't blight the results of the Pixel 3a phones' camera capabilities.



This is notable, as when we asked what this boded for the future of the high-end Pixel phones, a Google spokesperson told us the software wizardry learnt in the Pixel 3a development will help pave the way for Google to extract more out of its Visual Core

processor when it comes to the Pixel 4, expected in the autumn.

As this is the Labs section, we can dust off our crystal ball and predict that future Pixel cameras will have some serious smart capabilities behind them, from turning sloppily shot pictures into pleasing photos, to opening up more scope for augmented

reality features and intelligent image recognition.

It might seem like a small thing, but there's a good chance that advancements here could result in your smartphone's camera almost acting like a third eye, through which you can better see and understand your environment.



## THE LOWDOWN

# Smart device security labelling

The government wants to set security standards for smart and IoT devices

### WHAT'S THIS NOW?

Right, you know all the smart speakers, connected fridges, cameras and robot vacuum cleaners that you can easily waste a healthy amount of money on for tech kudos? Well, there's a good chance they aren't particularly secure and could be hacked either directly or through the network they are connected to.

That's not to say your Google Home or Amazon Echo speaker is a hacker's delight, but securing such devices can be tricky, as smart home technology is still rather new and the sector is filled with all manner of companies making their own smart kit. This is good news for people who want a steady stream of new gadgets, but it's bad news for folks paranoid about security, as there aren't really any solid widely adopted standards of security for these gadgets to conform to.

And then there are small internet-connected devices that fall under the Internet of Things (IoT) banner, including networked sensors. These devices don't always have the space or onboard processing power to secure and encrypt the data they suck up and communicate back across a network or the wider internet.

### SOUNDS WORRYING...

It is a little, which is why the UK government is trying to set some proper standards that smart home and IoT device makers will need to conform to if they want to peddle their wares to us.

Last year, the government's Department for Digital, Culture, Media and Sport published a code of practice for ensuring that security was considered at the design stage of smart and IoT devices, rather than slotted in as an afterthought or ignored.

This 'Secure by Design' code of practice was voluntary, although companies including Samsung, Panasonic and Hive quickly adopted it. But it doesn't force device makers into complying with its security guidelines.

The government is now looking at introducing a labelling scheme whereby devices that conform to security standards are clearly marked, thereby allowing consumers to separate them at a glance from devices that don't have up-to-scratch security.

### A BIT LIKE CE MARKS?

Pretty much. These secure labels will work in a similar way to the certification mark that shows an electronic device conforms with the health, safety and environmental protection standards of the European Economic Area.

What isn't clear under the label proposals, which are at the time of writing undergoing public consultation, is what will happen to devices that don't conform to the security standards and thus don't get labelled.

If the labelling is enshrined into UK law, it could mean that retailers might be forced to yank devices that don't have the security label off the shelves. Or it could mean that devices with the labels will end up with a competitive advantage over those that don't, as people are likely to choose a more secure device over one with less protection.

### THIS SOUNDS PRETTY SENSIBLE, RIGHT?

Yes, at least on the surface. It's a step in the right direction when it comes to smart tech and IoT device security, at least in the opinion of Dr Ian Levy, technical director at the National Cyber Security Centre (NCSC).



"Serious security problems in consumer IoT devices, such as preset unchangeable passwords, continue to be discovered, and it's unacceptable that these are not being fixed by manufacturers," he said.

"This innovative labelling scheme is good news for consumers, empowering them to make informed decisions about the technology they are bringing into their homes."

There are a few caveats, the first being that such labels aren't a guarantee of robust security as dodgy hardware makers could simply fake them in the same way CE labels get faked. The second issue is who's going to take responsibility for checking devices conform to the government's security standards.

It might be a case that companies self-certify, which could be a murky business, or an independent body might be needed to check that the standards are being met and are updated to reflect the changing nature of technology and evolving cyber threats.

There's potential here, and we stress we're basing this on speculation, that hardware makers will have to spend more time and effort into making their gadgets more secure and thus need to ramp up the cost of their products. This opens up the possibility of having a more secure device that might cost more than one that's easily hacked but comes at a tempting price.

### IS SMART DEVICE HACKING REALLY A THREAT?

If a malicious hacker were able to get access to a smart thermostat, they could play havoc with a household's heating, potentially ramping up energy costs or damaging the system. But other than messing with someone's life, there's not a lot for a hacker to gain from that.

However, hackers could also use smart devices as a way of infiltrating a home network and then snoop or steal data flowing across the network, snatching unencrypted passwords and login credentials for online services.

Another and perhaps more surreptitious hack is one that hijacks a smart device and uses it to form a botnet, a vast network of devices with some level of compute power that can be used to fuel distributed denial of service attacks or spread malware at high volumes. 📺

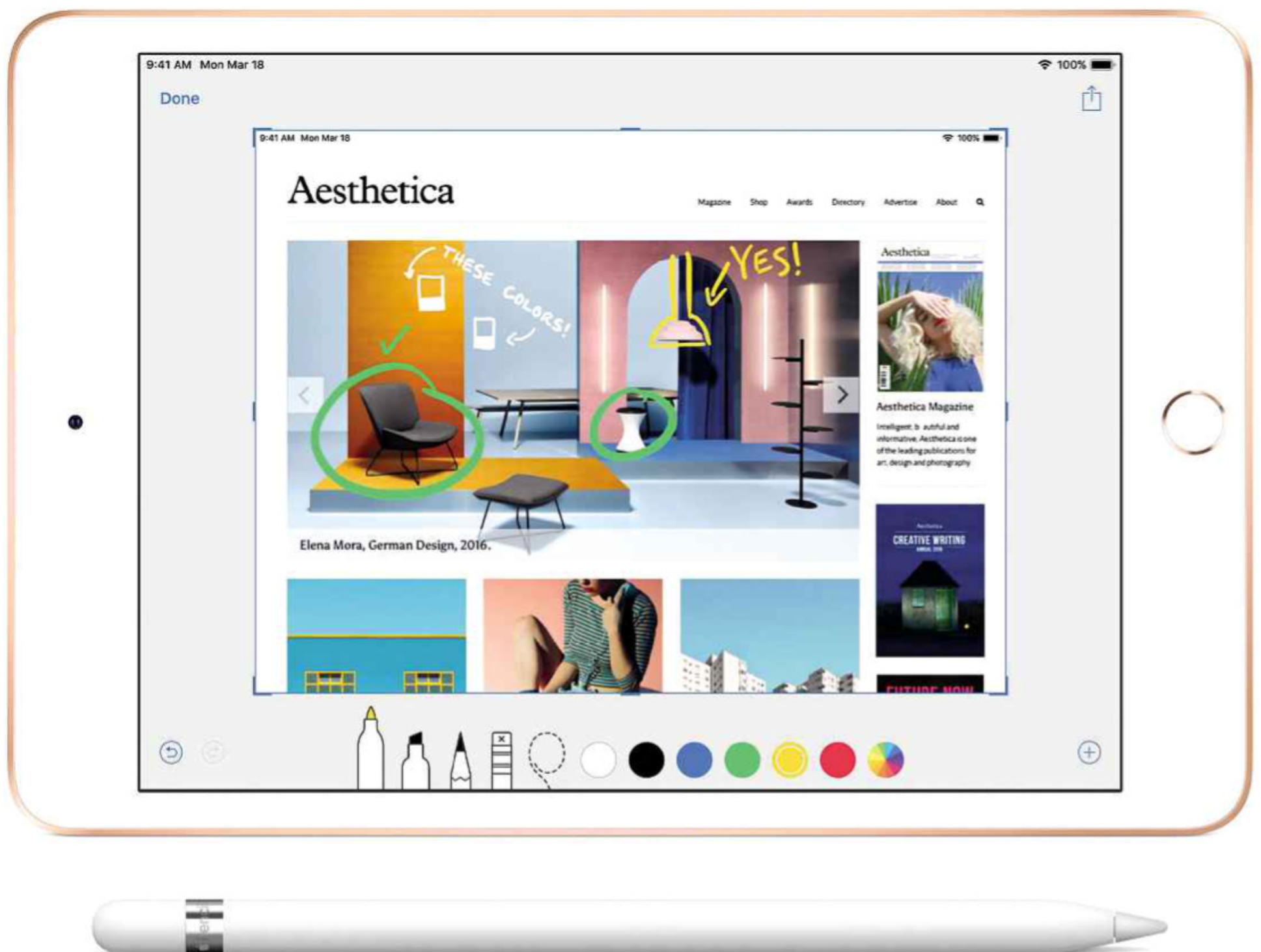
**"It's unacceptable that serious security problems in IoT devices are not being fixed by manufacturers"**



# REVIEWS

YOUR TRUSTED GUIDE TO WHAT'S NEW

## APPLE iPad Mini (2019)



iOS 12 TABLET



£399 • From [www.apple.com/uk](http://www.apple.com/uk)

### VERDICT

It might look just like the old model, but the new iPad Mini is a vastly more powerful tablet with an upgraded screen and Apple Pencil support



**FOR A PRODUCT** so popular – and made by a company so fond of annual refreshes – it's been an awfully long time since there was a new iPad Mini. The last, fourth-generation version launched in 2015, and what a different world we live in now.

It's all the more surprising, therefore, that this new fifth-gen iPad Mini doesn't appear to have changed much physically. The case design is the same, down to the last millimetre; the button positions are the same; and the screen is the same size and resolution, too.

That's a little disappointing. You might have thought Apple would have fitted some more contemporary upgrades, such as an edge-to-edge display, or perhaps removed the home button in the interest of a higher screen-to-body ratio.

Still, it's good to see that there have been some tweaks. Despite some familiar key specs, the display's underlying technology has been upgraded, while fresh internal, performance-critical components mean this is the fastest iPad Mini ever. And it's also now compatible with the first-generation Apple Pencil, making it a handy note-taking companion.

In typical Apple fashion, it's not cheap: we tested the most basic £399 model, with 64GB of internal storage and Wi-Fi-only connectivity. Splash out on the top £699 model, and you upgrade to 128GB of storage and mobile data as well as Wi-Fi. You can also get a couple of other combinations in between these storage and connectivity options.

## RECYCLABLE MATERIAL

On paper, the iPad Mini looks an absolute shoo-in for anyone looking for a smaller, more compact tablet, but we'll reiterate: physically, this tablet is no different to its four-year-old predecessor. That will probably be a disappointment for all those who like new, shiny toys.

There are positives to this design, however: it's still super-light, weighing a mere 300g; it's as slim as it ever was, at 6.1mm from front glass to rear panel; and it's small enough to slip into most bags without making much of an impact on weight or bulk. The downsides are that the tablet comes with enormous bezels surrounding the 7.9in, 4:3 aspect ratio screen. To say that the new iPad Mini might have been smaller and more compact would be a huge understatement.

With the tablet held in portrait orientation, you'll find the volume buttons located on the right edge at the top, the power button on the top edge at the right, the 3.5mm headphone jack on the top edge at the left, and the charger and speaker grilles on the bottom edge.

Even things you might have expected to change haven't done so. The iPad Mini still uses a Lightning cable to charge and transfer files, not USB Type-C like the newer iPad Pro models, and it doesn't have



Apple's Face ID security system, either. For quick unlocking and payments via Apple Pay, the iPad Mini is stuck with Touch ID. That's not a problem, however. Touch ID works as well as it always did: it's quick, reliable and very rarely fails.

## GETTING THE POINT

The only major new feature on this iPad Mini is Apple Pencil compatibility. Again, you may experience a touch of déjà vu as it's compatible not with Apple Pencil 2, but the first-generation stylus only. That means you'll have to put up with charging it, rather awkwardly, by removing the cap and plugging it into the Lightning port at the base of the tablet.

That's a bit of a pain but, again, it's not a huge issue. The original Apple Pencil still

works brilliantly – it's very responsive, with a 240Hz pen touch refresh rate, it's pressure-sensitive, and it captures your pen strokes almost as accurately as if you were using a pen and paper.

Indeed, more than any other iPad, the Mini makes perfect sense as a note-taking, annotation device and, now that there are hundreds of apps that take advantage of the Apple Pencil, it would be silly not to spend the extra and buy one along with your shiny new iPad Mini.

It's also worth noting that – just like Apple's cheaper £319, 9.7in iPad (Shopper 366) – the iPad Mini is compatible with third-party styluses. If you can't justify paying £89 for the Apple Pencil, you can – to give one example – pick a Logitech Crayon instead for £60.



There isn't  
much wrong  
with the 2019  
iPad Mini.  
It takes a  
popular recipe  
and updates it



### THE BRIGHT STUFF

That's it for major new features, but there are plenty of improvements, and one of them is the 7.9in display. It has a resolution of 2,048x1,536 for a pixel density of 326ppi, uses IPS technology and, impressively, supports both HDR 10 and Dolby Vision playback.

In a sense, at least. While the iPad Mini can play back HDR and Dolby Vision titles via Netflix and iTunes, the peak brightness of the display isn't high enough to give the full HDR effect. We measured it at 530cd/m<sup>2</sup>, which is more than enough for everyday use (including outdoors), but short of the 700cd/m<sup>2</sup> required for true HDR 10 playback. Dolby Vision is even more demanding, requiring a minimum of 1,000cd/m<sup>2</sup>.

Nonetheless, this is still a high-quality display. It delivers 91.3% coverage of the sRGB colour gamut, which is excellent, and colour accuracy is superb.

It's as sharp as anyone needs at this size, and also reads well in less-than-ideal conditions, mainly thanks to two factors. The first is full lamination, where the glass is stuck to the IPS LCD beneath it, eliminating any glare-inducing air gap; the second is a highly effective anti-glare coating. Both are features the 9.7in iPad doesn't have.

The anti-reflective coating, in particular, is remarkably effective at cutting down on reflections from the iPad Mini's glossy display, making it readable just about anywhere.

### DO THE ROBOT

However, the real reason for buying a new iPad Mini is this: it's incredibly powerful and responsive. In fact, with 3GB of RAM and the same hexa-core A12 Bionic chip inside as Apple's iPhone XR, iPhone XS and iPhone XS Max, it's an absolute beast of a tablet.

In Geekbench 4's single-core test, it scored 4,814, enough to breeze past the 9.7 iPad and Huawei's MediaPad M3, which scored 3,410

and 1,906 respectively. Its multitasking prowess is even better: its 11,551 score in Geekbench's multicore test is just over double that of the 2018 iPad.

The new iPad Mini is also far better than these other tablets at gaming: a 59fps result in GFXBench's Manhattan onscreen test, as well as 126fps in the offscreen test, show that more graphically intensive titles will run noticeably better than on the 9.7in iPad, with its onscreen test score of 41fps, and the MediaPad M5 (27fps onscreen).

There is a trade-off for all this power, however. Battery life has taken a bit of a dip from the fourth-gen iPad Mini: that lasted for 10h 43m in our video loop test, but this new model fell to 8h 21m. That's still adequate, and only a matter of minutes behind the more recent 9.7in iPad, but it's nonetheless a step back.

### WATCH THIS FACE

Tablets never make the most ergonomically friendly camera alternatives when you want to grab a quick snap, especially when most people have a smartphone in their pocket as well, but then the larger screen can make for a better viewfinder.

If you do prefer to use a tablet over your phone, the iPad Mini's camera won't disappoint; however, it won't astound with its quality. The main camera at the rear has an 8-megapixel sensor with an aperture of f/2.4, which shoots 1080p video at up to 120fps for slow-motion footage.

This is fine if the light is good – a little down on detail compared with a decent smartphone camera, perhaps, but not dramatically so – but it struggles to produce sharp shots in darker situations.

At the front – which is perhaps the more important camera for a tablet – you have a 7-megapixel FaceTime HD camera, which delivers superlative quality for video calls at

up to 1080p in HDR. If you're looking for a device to improve the quality of your video calls, the iPad Mini is worth considering for that alone. The camera is much better than you get on many modern Windows laptops.

### REPEAT SHOWING

Besides some exterior design stagnation, there isn't much wrong with the 2019 iPad Mini. It takes a popular recipe and updates it, adding more performance and Apple Pencil support along the way.

There's still the sense that Apple has missed an opportunity to do even more, however. In 2019, it's crying out for an edge-to-edge display or a Smart Keyboard connector to turn it into the ultimate compact 2-in-1.

Those hoping for a more affordable price will be disappointed, too. Although £399 isn't a huge outlay these days compared with prices for the iPhones and iPad Pro, it's still considerably more than Apple is asking for the larger, 9.7in regular iPad, which incidentally also has Apple Pencil support.

For all that, however, it's hard to criticise the iPad Mini too much when it's so superior to any of its rivals at this size. Despite its slightly old-fashioned appearance, it's still a great tablet. It's fast, it has a wonderful display, and is neat and pocketable.

Jonathan Bray

### SPECIFICATIONS

**PROCESSOR** Hexa-core Apple A12 Bionic • **SCREEN SIZE** 7.9in • **SCREEN RESOLUTION** 2,048x1,536 • **REAR CAMERA** 8 megapixels • **STORAGE** 64GB • **WIRELESS DATA** None • **DIMENSIONS** 203x135x6.1mm • **WEIGHT** 300g • **OPERATING SYSTEM** iOS 12 • **WARRANTY** One year RTB • **DETAILS** [www.apple.com/uk](http://www.apple.com/uk) • **PART CODE** iPad Mini 2019





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## OVERCLOCKERS XVI Gamer



£900 • From [www.overclockers.co.uk](http://www.overclockers.co.uk)

## VERDICT

A good all-rounder, but in exchange for slightly less power you can get a much better deal

## £200 CAN GO a long way in PC building.

This is well known to anyone who's attempted a DIY system: it can upgrade the graphics card to a whole other tier, it can massively boost storage capacity and speed, and it can get you a CPU with significantly more cores and multitasking muscle.

However, spread that £200 too thinly, and what initially seems like a major overhaul can end up feeling less worthwhile than if you'd focused on making just one or two key upgrades. This is precisely what's happened with the Overclockers XVI Gamer: at £900, it's £200 more than the Gaming XVI Essential (*Shopper 377*), and is inarguably a more powerful and better-equipped system. Whether it's worth the extra cash, however, is a different matter.

## COMPARE NOTES

First, a rundown of what's different between the two PCs, and what stays the same. The most notable non-change is that both have AMD's hexa-core Ryzen 5 2600 CPU, although since the XVI Gamer has 16GB of RAM – twice that of the Gaming XVI Essential – it should have the edge on multithreaded performance. Both systems also have a 240GB SATA SSD as their main storage drive, with a 1TB hard disk providing backup capacity.

Here, graphics power is drawn from the Nvidia GeForce GTX 1660 Ti, a direct – if minor – step up from the Gaming XVI Essential's GTX 1660. Both GPUs have 6GB of GDDR6 memory, but the GTX 1660 Ti has the advantage in core count, with 1,536 to the GTX 1660's 1,408.

The XVI Gamer also comes, it must be said, in a much slicker chassis. Instead of basic black plastic and an acrylic side window, this PC's case is a striking white number, with a full-sized tempered glass side panel. Through the latter, you can see a much cleaner internal chamber, thanks to the PSU shroud covering up more components and cables than the uncovered Gaming XVI Essential. The front panel is still made of plastic, but it's a pretty good approximation of metal, and the sharper

corners further contribute to an overall more grown-up look.

Except, perhaps, for the dazzling amount of RGB lighting. It's not that every single component has its own LEDs, but a set of two strips bathe the entire main chamber and then some. These are set to slowly cycle through different colours by default, and – almost entertainingly – they're strong enough to completely swamp the specks of additional RGB lighting on the motherboard. This will appeal to some, of course, but if you're not keen on throwing a disco on your desk, then you can tweak the colours or turn off the strips entirely.

## SAME CHIP, DIFFERENT DAY

CPU performance is, as expected, similar to that of the Gaming XVI Essential. In our 4K benchmarks, the XVI Gamer scored 135 in the image test, 212 in the video test, 248 in the multitasking test and 217 overall, so anything from basic browsing to home video editing will run just fine. The extra RAM doesn't seem to make an enormous difference: 248 is a nifty little improvement on the Gaming XVI

Essential's multitasking score of 231, but the difference in overall scores is just 10 points in the more expensive system's favour. In everyday use, there wouldn't be much of a tangible difference unless you're regularly hoarding browser tabs or running multiple high-intensity applications at a time.

The GTX 1660 Ti, too, doesn't prove itself to be a particularly pronounced upgrade on the standard GTX 1660. The XVI Gamer is still an appropriately capable gaming rig: in *Metro: Last Light*, the toughest of our test games, it managed a smooth 62fps at 1,920x1,080 with Very High quality and SSAA enabled. It even broke through the 30fps barrier at 2,560x1,440; with 36fps at this resolution

you can afford to disable SSAA for a big jump up to 69fps. 4K demands greater sacrifices, as the PC only makes it to 16fps with everything maxed out, but drop down to High quality with SSAA off and the resulting 46fps will suffice.

Undemanding games will zip along, judging by

*Dirt Showdown*. Here, the XVI Gamer never required the lowering of settings, as it sailed to 147fps at 1,920x1,080, 132fps at 2,560x1,440 and 75fps at 3,840x2,160, all with the Ultra quality preset and 4x MSAA.

By scoring 10.9 in the SteamVR Performance Test, a mere 0.1 off a perfect mark, the XVI Gamer also distinguishes itself as a great system for VR gaming. If you're unfamiliar with this test, it judges the extent to which you'd need to lower graphics quality settings in a big-budget VR game before achieving a stable 90fps; what a score of 10.9 means is that you could happily leave every setting at its best and still get the requisite smoothness.

Overshadowing all this success, however, is the fact that the Gaming XVI Essential performs almost as well, for £200 less. The biggest difference in these tests is the cheaper system scoring 114fps in *Dirt Showdown* at 1440p; otherwise, it's all just tiny gaps of 10fps or less.

It's perfectly fair to want that extra sliver of performance anyway, particularly if you want a PC for more competitive play. The issue is that no-one else will see much of a benefit with the GTX 1660 Ti compared to the GTX 1660.

## LOVING MOTHER

There's no additional storage space, either. Granted, the SSD's read speed is respectable for a SATA drive – we measured it at 519MB/s – but a write speed of 346MB/s is poor. For £900, we don't think it's unreasonable to expect a little bit more out of storage, whether it's a larger SSD or hard disk, or a switch to NVMe instead of SATA. The £700 Palicomp AMD Abyss and PC Specialist Apollo S2 (both *Shopper 374*) use this much faster SSD platform, so it's not necessarily out of reach.

It's telling that of all the hardware advantages held by the XVI Gamer over the Gaming XVI Essential, the most meaningful







is arguably the motherboard. The Gaming XVI Essential's was a basic board, but this one – an Asus TUF B450-Plus Gaming – has a much more generous selection of upgrade slots, including one spare PCI-E x16 and three spare PCI-E x1 slots. There's also an empty set of RAM channels and an M.2 slot, so you can easily add NVMe storage later if you wish.

The rear I/O panel is a good one, too. Instead of just USB2 and USB3 ports, you get two of each plus two faster USB3.1 ports and a USB Type-C connector. That's on top of a PS/2 port, Ethernet connector and three 3.5mm audio jacks, with the graphics card providing one HDMI output and three DisplayPort sockets. In the unlikely event that you run out of space on the back for peripherals, another welcome benefit of the case is its front I/O panel, which contains two USB2 ports and one USB3 port.

Internal storage upgradability is simple, but practical enough: there's room to easily add one more hard disk alongside the one that's already there, and a set of two 2.5in drive mounts behind the motherboard tray provide extra SSD space. The pre-installed SSD is affixed directly to a set of mounting holes on the chassis, and it looks like these could hold a couple more, were it not for some cable ties in the way.

### GO LOW

In case it wasn't already clear, we're not suggesting you rush out and buy the XVI Gamer, even if its biggest problem is the existence of the Gaming XVI Essential, rather than any serious design or hardware flaws.

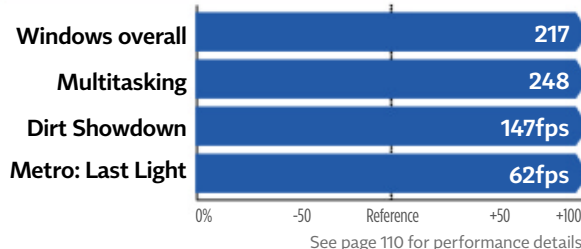
Most of the differences between the two look bigger on paper than they are in actuality, meaning you'd be paying £200 more for a PC with only marginally better gaming performance and almost identical CPU performance. The motherboard and case are clearly upgrades, but aren't worth the premium by themselves.

We wonder if it would have been better to focus on one aspect of the Gaming XVI Essential – which is already a great PC – and make that one aspect significantly better, instead of the XVI Gamer's approach of making small adjustments that ultimately don't add up to much. It's still a decent enough desktop PC, but the smart money would be put towards the Gaming XVI Essential, or potentially the AMD Abyss, which has a faster CPU and better storage than both.

*James Archer*

### SPECIFICATIONS

**PROCESSOR** 3.4GHz AMD Ryzen 5 2600 • **RAM** 16GB DDR4 • **FRONT USB PORTS** 2x USB2, 1x USB3 • **REAR USB PORTS** 2x USB2, 2x USB3, 2x USB3.1, 1x USB Type-C • **GRAPHICS CARD** 6GB Gigabyte GeForce GTX 1660 Ti OC 6G • **STORAGE** 240GB SSD, 1TB hard disk • **DISPLAY** None • **OPERATING SYSTEM** Windows 10 Home • **WARRANTY** Three years collect and return • **DETAILS** [www.overclockers.co.uk](http://www.overclockers.co.uk) • **PART CODE** FS-1DE-OG



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## CHROME OS MINI PC

# ACER Chromebox CXI3

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### VERDICT

**Small, speedy and surprisingly well connected, this is the best-realised Chromebox yet**

**THE RARITY WITH** which new Chromeboxes launch is at least partially balanced by each design coming in about half a dozen different specs. The Acer Chromebox CXI3 is a perfect example. You can have it with an Intel Celeron 3865U and 4GB of RAM for about £250, but the version we tested packs a quad-core, eight-thread Core i5-8250U, not to mention 8GB of RAM and a 64GB SSD.

That all makes it something of a powerhouse in Chromebox terms. Like their laptop counterparts, Chromebooks, Chromeboxes typically settle for less horsepower, and a focus on cloud-based applications and storage in order to stay more affordable than equivalent Windows systems. This particular £502 model might be stretching the concept, but it does allow for slicker, smoother everyday use than most Chromeboxes.

There's not a hint of slowdown when racking up browser tabs and running multiple applications, and booting up is almost instant. The CXI3's power is shown quite starkly in its Geekbench 4 benchmark results: 4,286 in the single-core test and 11,106 in the multicore test. Compared to the Celeron 3865U-powered Asus Chromebox 3 (*Shopper 368*) we tested last year, the CXI3 is almost twice as fast on single-core performance and scored more than five times higher in the multicore test. Even though the Chromebox 3 is half the price, the numbers still favour Acer's device.

### SMALL FAVOURS

The CXI3 also averaged 58fps in the GFXBench Manhattan 3 offscreen test, which is again about double what the Chromebox 3 managed. It's still relying on integrated graphics – Intel UHD Graphics 620 – but since you can only install mobile-focused games from the Play store, this will be enough to run just about anything that's actually compatible.

We love the design, too. It's truly tiny at just 149x40x151mm, and is

flexible in how it sits: you can have it laid down flat, stood upright with the included stand or even VESA-mounted to the back of a monitor with the (again, included) mounting plate and screws.

Being so dinky hasn't harmed connectivity, either. A total of five full-size USB3 ports (two at the front, three at the rear) are augmented by a USB Type-C port, which can output video if required. Alternatively, there's also an HDMI output on the back, along with a Gigabit Ethernet jack and Kensington lock slot. Lastly, the front panel adds a microSD card and combined microphone/headset 3.5mm jack.

This is a great mix for such a diminutive PC, and although the Asus Chromebox 3 offers largely identical connectivity, the CXI3 bests it by exclusively using USB3 ports, rather than a combination of USB3 and slower USB2 ports, as the Chromebook 3 does. Wireless capability hasn't been overlooked, either: both 802.11ac Wi-Fi and Bluetooth 4.2 are present and correct.

### OUT OF SHAPE

If you want to save some cash, you can fill two of those USB3 ports with the bundled mouse and keyboard, but we wouldn't recommend it. The only unappealing aspect of the CXI3 is the accompanying horrible, plasticky, ergonomic-unfriendly peripherals. The keyboard is particularly poorly made. It flexes to the point where not all the rubber feet are in contact with the desk, causing it to slip around in use. The fix, for want of a better word, is simply to bend it back the other way.

It also has the quintessential Chromebox

quirk of replacing the Caps Lock key with a search key – all the more reason to replace it, unless you're happy to relearn touch typing. We plugged in a random USB Windows-layout keyboard and it worked fine, Caps Lock and all.

Chrome OS itself is fine. The usual caveats about it lacking Windows' extreme

breadth of supported software apply, but a combination of the Chrome browser and Google Docs will suffice for many, and the Play store has ported versions of familiar apps such as Word as well. On the Asus Chromebox 3, we ran into issues with Chrome OS's snap-to-edge feature, whereby (as in Windows 10) you can drag an application to one side of the screen to have it automatically fill that half. Windowed apps would snap to one side but not fill the whole space, but luckily there are no similar issues here. The dual-app view works nicely, successfully improving the OS's potential for multitasking.

### GO BIG OR GO CHROME

The only other potential point of concern would be storage, but 64GB is only low by PC standards. Make proper use of cloud-based apps, as intended, and it's much easier to live with than the 32GB offered on cheaper Chromeboxes. You can always add more capacity through the microSD slot, anyway.

In fact, the CXI3 represents by far the most comfortable Chromebox experience we can recall having. It's both compact and well specified, attractively simple but able to handle heavier workloads if necessary. Pair it with a less terrible mouse and keyboard, and it's a superb little computer.

*James Archer*



### SPECIFICATIONS

**PROCESSOR** Quad-core 1.6GHz Intel Core i5-8250U • **RAM** 8GB DDR4 • **FRONT USB PORTS** 2x USB3 • **REAR USB PORTS** 3x USB3, 1x USB Type-C • **GRAPHICS ADAPTOR** Intel UHD Graphics 620 • **STORAGE** 64GB SSD • **DISPLAY** None • **OPERATING SYSTEM** Chrome OS • **WARRANTY** One year RTB • **DETAILS** [www.acer.com](http://www.acer.com) • **PART CODE** DT.Z0SEK.001



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## WINDOWS 10 CONVERTIBLE

# LENOVO Yoga Book C930



£1,300 • From [www.lenovo.com](http://www.lenovo.com)

### VERDICT

A laptop, tablet and e-reader, the Yoga Book C930 is a 3-in-1 – but master of none

**FOR A WHILE**, it looked as if the Lenovo Yoga Book (Shopper 348) wasn't coming back. The ultra-thin 2-in-1 was out of stock for months at a time and there was no sign of a replacement model. Now, however, it's been unexpectedly revived – and revamped – with the release of the Yoga Book C930.

We gave the last Lenovo Yoga Book top marks for versatility and innovation but weren't so keen on its sluggish performance and virtual HALO keyboard. The Yoga Book C930 is a significant step forward, with a higher display resolution and E-Ink secondary display that switches between keyboard, drawing and e-reader modes. The price has doubled since the last time, however, and even after testing we're struggling to understand why.

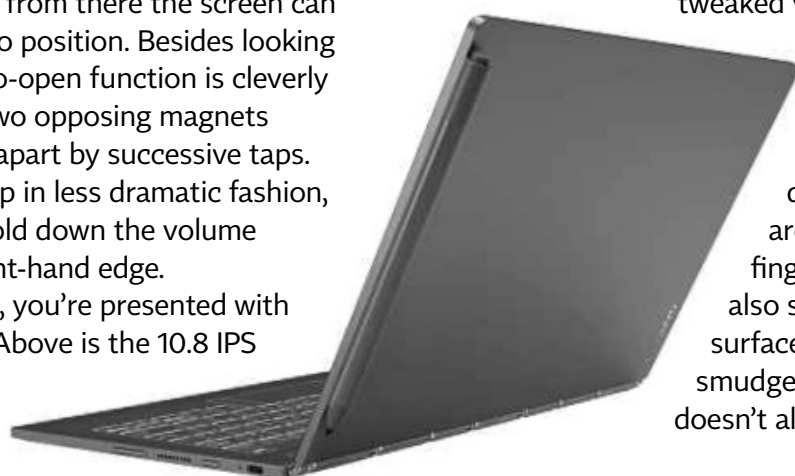
### TWO FOR ONE

Like all of Lenovo's Yoga devices, the Yoga Book C930 is a 2-in-1 touchscreen laptop with a 360° hinge. It's more compact than any other Yoga, however, weighing a dainty 0.75kg and measuring only 9.9mm thick when closed due to the absence of a physical keyboard.

The primary touch display and E-Ink display are both the same size, at 10.8in, but the former uses a higher-resolution, full-colour backlit 2,560x1,600 IPS panel. Inside our review model was a dual-core 1.2GHz Intel Core i5-7Y54, helped along by 4GB RAM. There's a 256GB SSD, which can be topped up with a microSD card up to a total of 512GB. The old Yoga Book was sold with the option of either an Android or Windows operating system, but Lenovo has killed Android off for the C930, which runs on Windows 10 Home exclusively.

To open it, you rap twice on the lid with your knuckle. This causes the lid to pop open a crack, and from there the screen can easily be lifted into position. Besides looking cool, this knock-to-open function is cleverly designed, using two opposing magnets which are forced apart by successive taps. To open the laptop in less dramatic fashion, you can simply hold down the volume button on the right-hand edge.

Once it's open, you're presented with the two screens. Above is the 10.8 IPS display, boxed in on all sides by

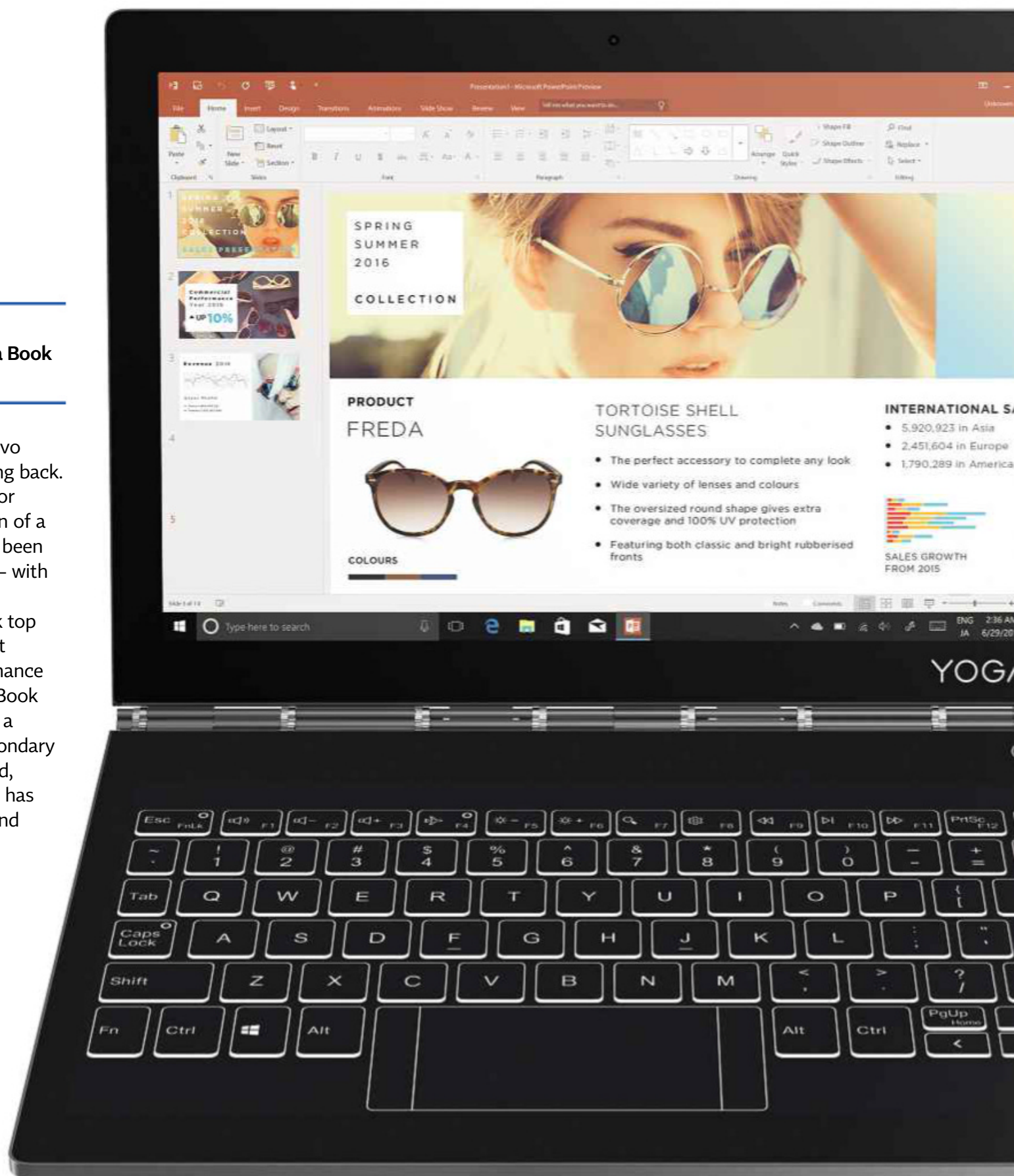


bezels that are conspicuously large for a laptop that was first revealed late in 2018. The webcam also lives above the screen, but there's no camera privacy shutter as there is on the similarly named Lenovo Yoga C930 (Shopper 377). There's also no secondary IR camera for face unlocking, even though the first generation Yoga Book had one.

### E-INK SPOTS

The E-Ink display resides where a keyboard would normally be, and fittingly uses a tweaked version of the

e-reader screen tech so that touch-based keyboard and drawing functions are enabled. A fingerprint reader also sits above this surface, but this smudges too easily, and doesn't always work.

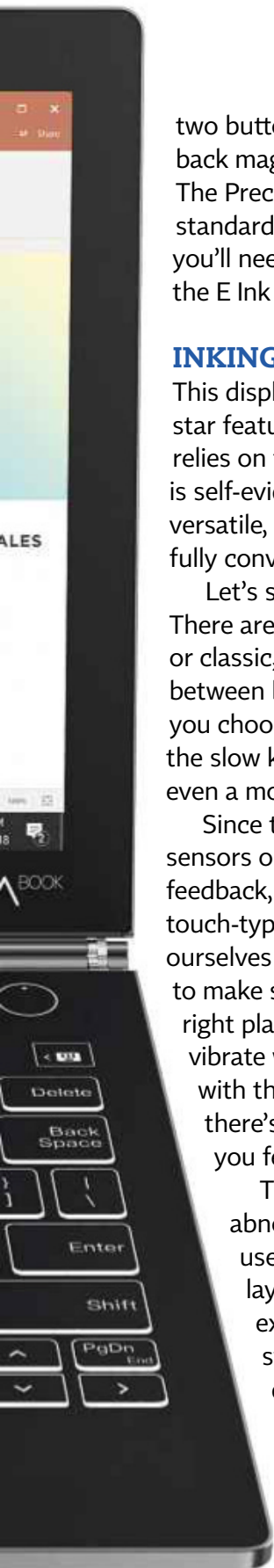


Those who are used to traditional laptops will have a tough time adjusting to the Yoga Book C930's lack of ports. In addition to a dual microSD and SIM slot on the left edge, there are two USB Type-C slots – one on either side – but one of those will usually be occupied by the power supply. That leaves you with a single connector to plug in a peripheral device. Lenovo hasn't even provided a 3.5mm audio jack for headphones, meaning you'll need to use an adaptor (not provided) or Bluetooth headphones to listen to audio privately.

And headphones are recommended, whether you're in public or not, because the audio output of the Yoga C930's dual side-mounted speakers could be better. Although not abysmal, it's not as loud or as crisp a sound as you'd expect from a laptop costing over £1,000.

As you're spending so much, it's also disappointing that the Precision Pen stylus isn't included; instead, it's a £90 extra. This is a battery-powered metallic stylus, slightly longer and thicker than a Bic Biro pen, has





two buttons, and sticks to the laptop's back magnetically when not in use. The Precision Pen isn't essential for standard touchscreen activities, but you'll need it to take full advantage of the E Ink display.

### INKING PROBLEM

This display is the Yoga Book C930's star feature, and the laptop's success relies on this working well. The appeal is self-evident, because it truly is versatile, but the practicalities aren't fully convincing.

Let's start with the virtual keyboard. There are two layouts available, modern or classic, and you can also choose between black or white styles. Whatever you choose, there's no getting around the slow key response, which lags behind even a modest typing speed.

Since these aren't real keys but rather sensors on a panel, they have no tactile feedback, making it immensely difficult to touch-type. When typing, we found ourselves looking down almost constantly to make sure our hands stayed in the right place. You can set the keyboard to vibrate when you hit a key, but even with this set to maximum strength there's not enough sensation to make you feel as if you're actually typing.

The virtual touchpad is also abnormally small and frustrating to use. In the 'modern' keyboard layout it's just a small button that expands when you tap it, swallowing the spacebar and disappearing when any other key is pressed.

### OUT OF TOUCH

Annoyingly, the Precision Pen stylus can't interact with the E Ink surface in keyboard

mode. When you're already holding the stylus, it feels as though this would be more intuitive than bringing up the main display's onscreen keyboard, which obscures the entire bottom half of the screen. In Note mode, it works perfectly, although this mode isn't without its problems, either.

To begin with, the Yoga Book C930 is slow to swap between keyboard and Note functions, and sometimes it fails to load entirely. Many times we tapped the Note button on the E Ink panel and were presented with a blank display for five seconds, only to be brought back to the keyboard. When we did make it to Note mode, it was accurate and responsive, both for drawing and writing.

There's a button that allows you to draw with your fingers, and Note mode also has a screen-grab function for annotation purposes. Simply press one button and the main display is mirrored on to the secondary display. Of course, the E Ink Note mode is entirely black and white, which may not be an issue when annotating a Word



document or a PDF, but for designers and artists, the lack of colour is hardly ideal.

The third and final use of the E-Ink display is turning the Yoga Book C930 into an e-reader. Lenovo doesn't list all the formats you can read in this mode, but it's at least compatible with EPUB, MOBI, TXT and PDF. Kindle File Format, unfortunately, isn't currently supported.

Reading ebooks and PDFs on the display is awkward, to say the least. Because said display is attached to a laptop, it's unwieldy to use on the go and cannot be held comfortably or safely in just one hand. It's much easier to prop up the laptop in 'tent' mode and read hands-free. Page turning works by tapping the corners, but this often elicits no response. There's also the option to keep the laptop flat and read in landscape mode, and you can turn this into a two-page spread with two smaller pages visible side by side. It's still a bit unwieldy, however, and the lack of Kindle ebook support will be offputting to many.

### SLOW ZONE

The Yoga Book C930's primary display is a more regular affair. It has excellent sRGB colour gamut coverage of 97.2%, although there is a tendency to oversaturate across much of this range; green, reds and yellows are where it's worst. The screen is a touch on the reflective side, and this effect is worsened by the weak maximum brightness of 308cd/m<sup>2</sup>. Put simply, it's hard to view the display outdoors or under bright lights. The 1,174:1 contrast ratio is fine, however, and it's perfectly possible to get a satisfactory viewing experience out of this IPS panel.

Performance, sadly, falls well short of £1,300 laptop standards. It scored a paltry 25 overall in our 4K benchmarks, including just a single point in the multitasking test, with the low-power Core i5-7Y54 struggling to come anywhere near the Core i5-8250U of the more conventional Yoga C930. This only costs £54 more, but scored a much higher 80 overall.

The Yoga Book C930 can still handle a bit of multi-tab browsing, but you can forget about demanding video editing and gaming. Even Dirt Showdown, which can run playably on certain integrated graphics, only averaged 16fps with a lowered 720p resolution.

SSD performance is better, with the 256GB drive recording a sequential read speed of 1,200MB/s and a sequential write speed of 531MB/s in AS SSD. Battery life, however, drags the Yoga Book C930 back down, as it could manage only a mediocre 6h 16m of looped video playback. If you're planning to take the Yoga Book C930 out of the house, make sure your charger comes along as well.

### JUDGING A BOOK

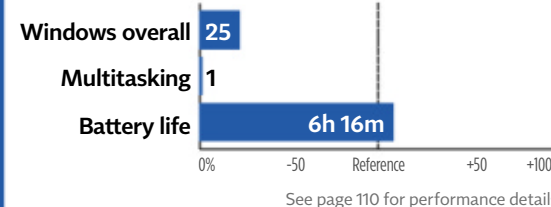
There are some good things here: the Yoga Book C930 is easily one of the most portable Windows 10 laptops ever, and the E-Ink display makes it incredibly versatile – when it works.

Still, even this is riddled with flaws and annoyances, and while we could look past a dodgy typing experience on the cheap first-generation Yoga Book, it's much harder to forgive at £1,300. That goes for a lot of other things, too. If you're paying this much, you should really be entitled to much better performance, connectivity and battery life than the Yoga Book C930 can offer.

Tom Bruce

### SPECIFICATIONS

**PROCESSOR** Dual-core 1.2GHz Intel Core i5-7Y54 • **RAM** 4GB • **DIMENSIONS** 260x179x9.9mm • **WEIGHT** 775g • **SCREEN SIZE** 10.8in • **SCREEN RESOLUTION** 2,560x1,600 • **GRAPHICS ADAPTOR** Intel HD Graphics 615 • **TOTAL STORAGE** 256GB SSD • **OPERATING SYSTEM** Windows 10 Home • **WARRANTY** One year RTB • **DETAILS** [www.lenovo.com](http://www.lenovo.com) • **PART CODE** Yoga Book C930







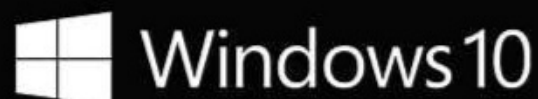
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## GAMING GRAPHICS CARD

# ZOTAC Gaming GeForce GTX 1650 OC



£138 • From [www.novatech.co.uk](http://www.novatech.co.uk)

### VERDICT

The GTX 1650 is Nvidia's most powerful budget GPU yet, but it faces a strong challenge from the newly cheap RX 570

**ALMOST A YEAR** after Nvidia first announced its next-generation RTX 20-series cards, we finally have a replacement for the entry-level GTX 1050 as well. The GTX 1650 is a world away from the monster frame rates and real-time ray-tracing of its RTX cousins, joining the GTX 1660 Ti (*Shopper 377*) and GTX 1660 in the more affordable 16-series, but it's still an interesting proposition, especially when it's in the tiny form factor of this Zotac model.

The underlying GPU is the cheapest of Nvidia's current crop, and without a GTX 1650 Ti to compete with, is the only truly 'budget' GPU of the entire generation. To help shoulder this responsibility, it has 4GB of GDDR5 memory – twice that of the GTX 1050 – as well as an increased CUDA core count of 896.

GTX 1650 processors have a stock boost clock of 1,665MHz, but Zotac has overclocked this ever so slightly to 1,695MHz. Its design comprises a simple, single-fan cooler, with the bare minimum of video outputs on the rear: one HDMI port, one DisplayPort and one DVI-D connector. There's no VirtualLink USB Type-C port for VR headsets, as you'd get on the 20-series cards.

This simplicity has its benefits. At only 151mm long, it's about as minuscule as GTX cards come, and there are no 6-pin or 8-pin PSU power connectors because it doesn't need any. The GeForce GTX 1650 OC can be powered entirely through its PCI-E x16 slot on the motherboard, which when combined with its small stature, makes it potentially perfect for compact PC builds where the case might not allow for longer cards or have adequate cable routing.

### GO GO GO

It's no surprise that the GTX 1650 outpaces the GTX 1050 on core performance, but in most tests it's markedly faster than the GTX



1050 Ti as well. This is most dramatically visible in our Dirt Showdown test, where at 1,920x1,080 with Ultra settings enabled, the newest GPU averaged 101fps – far more than the GTX 1050, which managed 74fps, and the GTX 1060 Ti's 81fps. It's also a highly favourable matchup against AMD's Radeon RX 560, another budget GPU, which scored 75fps.

The GTX 1650 has improved ability at 2,560x1,440, too: at this resolution it stayed smooth in Dirt, producing 76fps with Ultra settings still in place.

More graphically demanding games will push the GTX 1650 to its limits. Metro: Last Light Redux averaged a barely acceptable 31fps at 1,920x1,080 with the Very High preset, and going up to 2,560x1,440 dropped this to a spluttering 17fps. Nonetheless, at least it actually reaches the 30fps mark at 1080p, where the GTX 1050, GTX 1050 Ti and RX 560 all fall short. 1440p isn't entirely out of the question, either: turn off SSAA and 17fps jumps to 34fps, enough to get by with.

### COUNT UP

Tomb Raider runs well, too, with its integrated benchmark ending at 77fps at 1,920x1,080 and 48fps at 2,560x1,440, both with the Ultimate quality setting and FXAA smoothing out edges. Once again, that's a total victory for the GTX 1650 over its budget rivals, as at 1080p, the GTX 1050 produced 55fps, the GTX 1050 Ti 62fps and the RX 560 a mere 49fps.

Finally, although we wouldn't call this an ideal graphics card for VR, it can handle most current games at medium settings. That's according to the SteamVR Performance Test, which gave it a medium-tier score of 5.4.

Performance-wise, the GTX 1650 leads the way on what you can expect from an overtly low-end GPU. Of the other three, the only one that's still worth buying is the GTX 1050, and that's only if you absolutely can't spend more than £100.

However, it's not just budget cards that the GTX 1650 has to contend with. The Radeon RX 570

(*Shopper 357*) has plummeted in price from the mid-£200 range to between £120 and £140, putting this mid-ranger right next to Nvidia's latest. The specific Asus ROG Strix RX 570 model we tested is just £129, and its own benchmark results confirm that it's a far better deal: at 1080p, it scored 118fps in Dirt, 45fps in Metro and 92fps in Tomb Raider.

### KEEP IT SHORT

That's a heavy blow to the GTX 1650 as an actual buying proposition, but it's not necessarily a fatal one. Its petite dimensions allow it to fit into Mini-ITX cases that even smaller partner variants of the RX 570 can't, and it's a lot more efficient, too. We recorded Asus's RX 570 using up to 155W under load, but according to GPU-Z, the RX 560 only ever peaked at 90% of its 75W TDP – about 68W.

Despite the single fan, the GTX 1650 also runs quietly and very cool. An ideal temperature of 30°C is fine, but the GTX 1650's load temperature of 53°C is downright excellent, and it only peaked at 54°C. That's much chillier than the RX 570, which generally ran at around 72°C.

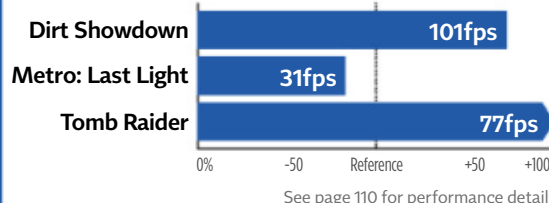
Of course, the main reason to buy a graphics card is performance, and on that alone the RX 570 is unquestionably the better buy. For the niche appeal of its size and efficiency, the GTX 1650 scrapes a fourth star, but a recommendation applies only if you specifically need a smaller, more discreet GPU.

*James Archer*



### SPECIFICATIONS

GPU Nvidia GeForce GTX 1650 • MEMORY 4GB GDDR5 • GRAPHICS CARD LENGTH 151mm • WARRANTY Five years RTB • DETAILS [www.zotac.com](http://www.zotac.com) • PART CODE ZT-T16500F-10L





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## MINI-TOWER CASE

# SILVERSTONE

## Precision Series PS15



£40 • From [www.scan.co.uk](http://www.scan.co.uk)

### VERDICT

Its small stature might affect your component choices, but otherwise the PS15 is an appealing and affordable microATX case

**£40 IS INARGUABLY** a rock-bottom price for a PC chassis with features like a full-size tempered glass side panel, largely metal construction (rather than plastic), an included fan and multiple USB3 ports. There are lots of cheap microATX cases, but the PS15 looks like one that could deliver a rare degree of value.

At the same time, this is ultimately a small case, and SilverStone has been pretty ruthless in cutting things down. For instance, there's only room for a single 3.5in hard disk in the entire thing. This comes in the form of a tool-less tray, which is nice, but that limits the ability to maximise storage on the cheap or set up RAID arrays with mechanical drives.

In addition, despite decent CPU cooler height and graphics card length clearances of 154mm and 314mm respectively, the PS15's maximum PSU size is 150mm. This isn't a deal-breaker as it still leaves you with plenty of options, but some PSUs – including more budget-inclined units that might have been a good pairing with an affordable chassis such as this – are 160mm long, so you'll have to check before you buy.

### GANG OF FOUR

Even with these limitations, however, the PS15 is generally welcoming to simple and advanced PC builds alike. The shortage of 3.5in trays, for one, is counterbalanced by a clutch of three 2.5in mounts, all of which use a convenient

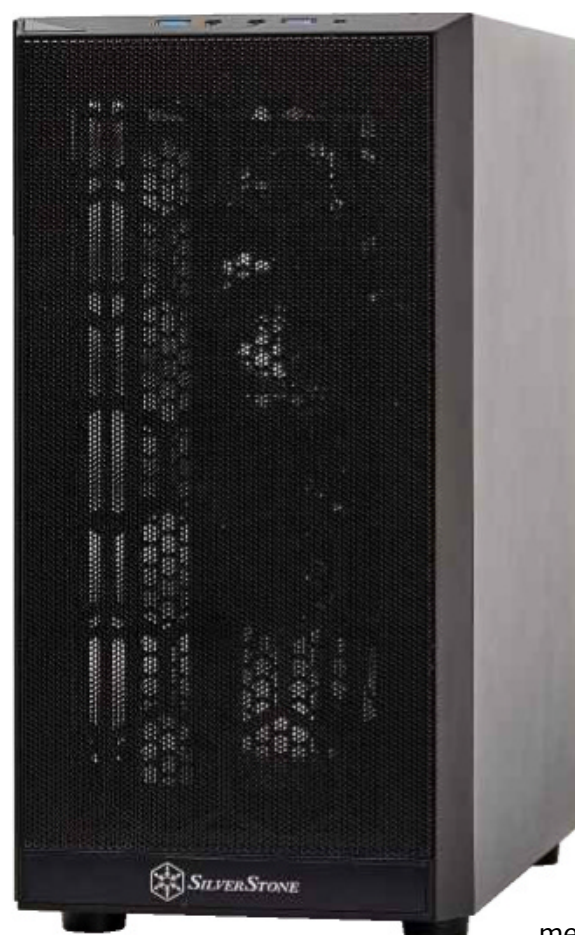
slotting system that allows for any screwdriver work to be performed outside the case. If you wish, you can also have yet another 2.5in drive in place of the 3.5in drive, as the latter's dual-purpose tray can fit either.

Cooling support is good, too. The front can hold two 120mm fans or two 140mm fans, the top can hold two 120mm fans or a single 140mm fan, and the rear 120mm slot already has an exhaust fan pre-installed. The gold standard is, of course, pre-installed fans at both the front and rear, but one at the back will suffice for budget builds. The all-mesh front panel is also better for ventilation than a solid sheet would be.

### COOLER SHAKER

Radiator support is where things get tricky, and, as with PSUs, you'll need to be cautious about installing a watercooler. The rear 120mm slot can have a 120mm radiator installed without issue, and although the top mounts don't have room for both fans and a radiator – there's not enough clearance between the roof and the top of the motherboard – that's fair enough, as long as it's simple.

The front slots, on the other hand, complicate things. Although two 140mm fans will just about fit, a 280mm radiator won't – the added length of where the coolant tubes run in and out means that the radiator as a whole is too big, and bumps into the front I/O panel's cables. A 240mm radiator can squeeze in, but again it's a tight fit. Either way, it's a shame that SilverStone couldn't or wouldn't find an extra few centimetres; we can't recall seeing many other cases that can have dual fan slots but can't accommodate the equivalent radiator size due to the length, rather than width. The PS15 still meets relatively high standards for mini-tower cooling by supporting 140mm fans in the first place, but if you're planning on a liquid-cooled build, 240mm will be your largest option.



Cable management is mixed as well. There are plenty of routing holes and a particularly large abundance of small metal loops, through which you can thread the included zip

ties to bunch wires together. However, there are no reusable straps or dedicated routing channels, no rubber grommets and only a very narrow area behind the motherboard tray, so thicker PSU cables need to be spread out rather than tied into tidy bundles. Unlike in the Thermaltake Versa H18 (*Shopper 369*), there's no PSU shroud either, so you can't just hide loose cables by stashing them underneath a convenient metal shelf.

Clearly there are drawbacks to buying so cheap, but then for every constraint, the PS15 pulls out a great piece of design. The most visibly obvious is that glass side panel, a bona fide premium touch, which helps both the chassis and the finished build look smart and modern. We also like how the SilverStone logo at the front glows blue when the power is on: it adds a dash of flair without crossing the line into full RGB madness.

Having two USB3 ports at the front is good for the price, as even much more expensive cases can settle for slower USB2 sockets. You also get easily removable dust filters at the front, top and bottom of the PS15, making it easier to clean.

### LITTLE FRIEND

With these qualities in mind, not to mention the Versa H18 becoming harder to find in stores, the PS15 just scrapes a Recommended award. There are some genuine flaws here, but none that would totally put the brakes on a good PC build – and none that, if you're trying to save money on the chassis to go towards a better CPU or graphics card, you should be unwilling to put up with for £40.

*James Archer*



### SPECIFICATIONS

**CASE TYPE** Mini-tower • **MOTHERBOARD COMPATIBILITY** MicroATX, mini-ITX • **SUPPLIED FANS** 1x 120mm • **MAXIMUM 3.5in DRIVE BAYS** 1 • **MAXIMUM 5.25in DRIVE BAYS** 0 • **DIMENSIONS** 381x192x351mm • **WEIGHT** 3.5kg • **WARRANTY** One year RTB • **DETAILS** [www.silverstonetek.com](http://www.silverstonetek.com) • **PART CODE** SST-PS15B-G



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## EXTERNAL SSD

# ADATA SD600Q



£60 • From [www.alternate.co.uk](http://www.alternate.co.uk)

### VERDICT

The odd performance wobble isn't enough to spoil this cheap and colourful SSD

**AS USEFUL AS** external SSDs can be, genuinely interesting examples are few and far between. Recently, the only two that have really stood out are the Samsung X5 (*Shopper 370*) and T5 (*Shopper 358*). Besides these coming from the same manufacturer, they also share the same traits of high speeds and high prices.

In short, there's room for something that's a little different, while also costing less than Samsung's premium drives, and the Adata SD600Q might well be it. With an eye-catching design and overdraft-dodging pricing, it's got charm to spare, and that's not something you can say about most storage hardware.

### FUDGING THE NUMBERS

It's not exactly packing bleeding-edge tech, however. Adata rather sneakily claims – on its website, the packaging and the documentation – that the SD600Q uses a USB3.1 connection. This is true in a sense, but it's only USB3.1 Gen 1, or USB3 by another

name. This has a lower 5Gbit/s throughput than 'true' USB3.1, also known as USB3.1 Gen 2, which can hit 10Gbit/s. It's nicely put together, too, even with some slightly flimsy plastic. This is largely down to the patterned, textured silicone that extends in an X shape to all four corners. Because this is raised slightly over the plastic bits, it's almost impossible for the latter to come into contact with surfaces. That, and the rubbery softness of the silicone, grants the SD600Q a limited degree of shock-proofing. Adata has apparently drop-tested it from 1.2 metres, and we didn't suffer any problems after dropping it from similar heights.

The silicone can also optionally add a dash of colour: blue or red on the two smaller capacities, although the 960GB model only

comes in black. All three models, however, are cutely compact at 80x80x15.2mm, and with an airy weight of 60g, the SD600Q is well and truly pocket-sized. You'll just have to find room for the 330mm-long detachable USB cable as well.

test: 544MB/s to the T5's 457MB/s, crashing through its official speed estimates in the process. It's highly unusual for a drive to do better in our Windows transfer tests than in the synthetic CrystalDiskMark, but repeated testing showed this wasn't a fluke. Otherwise, the T5 remains a much faster external SSD. The SD600Q's huge files read speed may be brilliant, but its 314MB/s write speed is much more down to earth, and its showing in the large files test was middling, too. Its 389MB/s read speed and 300MB/s write speed are further proof that the SD600Q is significantly better at one type of workload than the other.

A 239MB/s read speed result in the small files test is pretty good, although yet again, write speeds couldn't match it, coming in at 192MB/s. That's getting close to mechanical hard disk territory, so if you're likely to be dealing with lots of little files at once (as the small files test entails), be prepared.

### MONEY TALKS

One standout read speed result won't be enough to bother the mighty T5, and we'd still recommend Samsung's SSD if performance is paramount. The SD600Q still has plenty of appeal, however – speed discrepancies with the T5 are a lot easier to look past when you're paying close to half as much, and some bold design touches help mask the fact that this is a budget-friendly drive. There may be quicker SSDs, but the SD600Q is a capable – and interesting – alternative.

*James Archer*

## Amazingly, Adata's SSD outpaced Samsung's T5 in our huge files transfer test: 544MB/s to the T5's 457MB/s, crashing through its official speed estimates in the process

While this means you can plug the SD600Q into USB3 ports – which are far more common on PCs and laptops – without any sense that you're hamstringing performance, it also means you shouldn't expect that performance to be particularly blazing in the first place. Adata itself claims some merely decent maximum read and write speeds of 440MB/s and 430MB/s respectively, about on a par with a budget internal SATA SSD.

Still, it's cheap enough that lower speeds aren't a turn-off in themselves. We tested the 480GB version, which works out at a very attractive 12.5p per gigabyte. There's also a 240GB model, which is 15.6p per gigabyte, and a 960GB model, which is the best value of the bunch at just 11.2p per gigabyte. Compare and contrast with the Samsung T5, which has been around since 2017 and still costs 20p per gigabyte for the 500GB model.

Performance testing with CrystalDiskMark initially yielded some disappointing results: the standard sequential test typically sees storage drives hit their highest quoted speeds, but the SD600Q only managed a read speed of 303MB/s and a write speed of 398MB/s. The 4K test was punishing, too, with the SD600Q averaging a 98MB/s read speed and a 92MB/s write speed – relatively better than the sequential results, but nowhere near the Samsung T5's 299MB/s read speed and 203MB/s write speed.

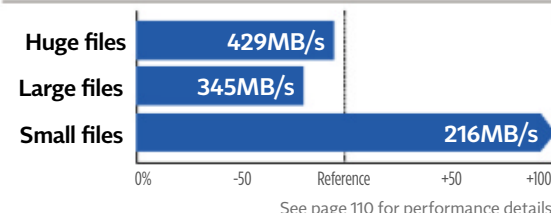
### OVERWRITTEN

Amazingly, however, Adata's SSD outpaced the T5 (which actually does use a proper USB3.1 connection) in our huge files transfer



### SPECIFICATIONS

**CAPACITY** 480GB • **COST PER GIGABYTE** 12.5p • **INTERFACE** USB3 • **CLAIMED READ** 440MB/s • **CLAIMED WRITE** 430MB/s • **WARRANTY** Three years RTB • **DETAILS** [www.adata.com](http://www.adata.com) • **PART CODE** ASD600Q-480GU31-CBL







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£107 • From [www.amazon.co.uk](http://www.amazon.co.uk)

VERDICT

Despite the name, there's not much new in HP's travel-friendly Sprocket printer

**HP'S SPROCKET NEW** Edition is a fun, highly portable photo printer aimed at students, backpackers and anyone who can't bear to be away from a printer. About the size of two smartphones stacked on top of each other, it prints only on special 2x3in ink-free paper, which you can buy in packs of 10, 20 or 50 sheets. Peel off the backing paper, and prints will stick to your laptop lid or the student fridge. Their quality is fine for keepsakes, but not on a par with a good inkjet print.

Nobody seems sure what to call this updated version of the original Sprocket (*Shopper* 357): HP itself refers to it as both the Sprocket New Edition and Sprocket 2nd Edition, while online stores have mostly gone for Sprocket 200. Visually, the printer has moved from a slick, glossy lozenge to an odd, speckled matt block. With the useful addition of a fabric hanging tag, our grey sample looked like an unused bar of soap from a 1980s Christmas.

The new model is slightly faster, completing an image every 53 seconds,



rather than every minute. It gets warmer than we remember when plugged into any available USB port or charger, and the lid's magnetic clasps don't seem firm enough. We recommend buying an (optional) travel case.

SPROCKET AND SEE

There are no PC or Mac drivers, but HP has managed not to drop the soap with its updated iOS and Android Sprocket apps. Visually appealing, they walk you through pairing the printer and phone, then encourage you to agree to location and other data sharing. While we usually opt out, here your data powers the new Reveal feature: take a photo with the Sprocket app's camera, print it out, then Reveal can use the phone camera to recognise it and 'augment' it with related information.

In the context of backpacking or other memorable experiences, Reveal is an interesting idea. It works for anyone with the Sprocket app who's opted in, so you could take a group selfie and print everyone a copy to serve as a kind of enhanced keepsake. In our tests, however, the Reveal information was limited just to other photos taken on that date or location, together with Wikipedia content describing the nearest landmark – potentially fun, but not as useful as, say, a way to keep in touch with others in the photo. Also, if you forget to use the Sprocket

camera app, the only thing that's revealed is other photos taken on the same date.

IN WITH THE OLD

For many, the Sprocket New Edition will be an expensive indulgence in the age of Instagram and Facebook, but for a few it could be a fun way to print and share memories, much in the spirit of the Polaroid camera. It could be a great gift to a backpacker, provided they can afford the 45p or so each print costs.

The Sprocket New Edition faces new competition from Canon's Zoemini range, and its dull-as-dishwater makeover won't help. It's a great toy for those who see the appeal, but we'd rather have HP's prettier, original Sprocket, and spend the £10 saving on a case.

Simon Handby



↑ The Sprocket app can recognise a photo and augment it with other information

SPECIFICATIONS

TECHNOLOGY Thermal paper • MAX PRINT RESOLUTION 313x400dpi • DIMENSIONS 25x80x118mm • WEIGHT 172g • MAX PAPER SIZE 2x3in • WARRANTY One year RTB • DETAILS [www.hp.co.uk](http://www.hp.co.uk) • PART CODE 1AS85A

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Mixed colour speed	N/A
Mono page cost	N/A
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0% -50 Reference +50 +100  
See page 110 for performance details



## 4K MONITOR

# SAMSUNG Space Monitor



£450 • From [www.overclockers.co.uk](http://www.overclockers.co.uk)

### VERDICT

Samsung's clever design minimises clutter, but image quality is below par

**IN THE BAD** old days before LCD screens became affordable, your monitor used to be the biggest thing on your desk. It was two feet deep and weighed as much as a sack of potatoes. By comparison, most modern LCD monitors are positively skinny, but even these can still have space-hogging stands. That's where the Samsung Space Monitor comes in.

It's a monitor for people who hate clutter, with an arm that minimises the amount of space the screen takes up on your desk. It's not the first time a manufacturer has done this – Dell's U2717DA is one of a few examples to have come and gone over the years – but the Samsung looks the most elegant so far.

### LITTLE AND LARGE

The Space Monitor comes in two sizes. There's a 27in model with a 144Hz, 2,560x1,440 panel and a larger, 32in model with a 60Hz, 3,840x2,160 panel, which we tested. Both use vertical alignment (VA) tech, and have the same aesthetics and space-saving design.

Unlike traditional monitors, which sit on the surface of your desk, you mount the Space Monitor using a clamp that attaches to the rear of your desk. This clamp occupies a small, semi-circular area of desk space, but it's minimal compared with a normal monitor.

Better still, the hinged arm that links the screen with the clamp offers a huge amount of flexibility. If your desk is backed up against a wall, the design of the arm is such that it will sit flush when it's not in use, taking on the appearance of a small, wall-mounted TV, with all cables tucked neatly away within the arm.

When you need it, it can be effortlessly pulled towards you and, despite the unusual design, you still get between -5° and 20° of tilt and 184.7mm of height adjustment. Throughout the monitor's design, it's refreshing to see Samsung has retained minimalism as an ethos. The three-sided bezel-less frame minimises the monitor's silhouette, while its textured rear panel and frame ensure it looks great from any angle.

There are some limitations here, however. You can't, for instance, have the monitor sitting at its peak height when it's fully extended, nor can you pivot or rotate the display. It's also worth checking whether your desk is compatible. While the clamp will fit desks up to 90mm thick, it will only work if there are no impediments to the clamp underneath, which some designs can have.



Also worth noting is that there are only two ports: mini DisplayPort and HDMI 2.0. The lack of full-sized DisplayPort or multiple HDMI ports might be a concern for those using multiple sources, but it at least ensures cable mess is kept to a minimum. Indeed, Samsung is positively encouraging cable minimalism by including a combined HDMI and DC power cable in the box.

### STRIKE AN IMBALANCE

Assuming your desk plays nicely with it, and you're happy with the limited connectivity, it's an easy design to live with. It's pretty simple to operate, too. Although there are no controls at the front, the clickable joystick at the rear means accessing and navigating the monitor's onscreen display (OSD) is an absolute doddle.

Considering how much effort Samsung has put into the design of the Space Monitor, we'd expect the same attention to detail and care to have been taken over image quality. Unfortunately, Samsung doesn't factory-calibrate the Space Monitor, and colour accuracy suffers as a result.

Out of the box, achieving an average delta-E of 2.55 and a peak of 4 in Normal mode (tested against sRGB) isn't disastrous, but you can do better for the money. To our eyes, the Space Monitor also looks washed out, and it took fiddling with the gamma settings to sort it out. This tweak, however, makes colour accuracy even worse, forcing the average delta-E to 4.19 and the peak to 7.08 (again tested against sRGB). And, while the monitor's sRGB gamut coverage sits at 99.2%, the gamut volume misses the mark at 126.9%. By comparison, both the Samsung VA-based C24FG70 and BenQ's HDR-enabled PD2700U offer far more colour-accurate picture quality.

A peak brightness of 340cd/m<sup>2</sup> isn't overly impressive, and neither is brightness uniformity, with a deviance of around 18% in each corner, so pictures won't appear as accurate near the edges as they would at the centre of the monitor. And with the refresh rate capped at 60Hz, no low-input-lag mode or FreeSync/G-Sync options, the Space Monitor is also unsuitable for keen gamers.

### STYLE OVER SUBSTANCE

Samsung's attempt to rekindle interest in footprint-minimising monitors is commendable, and the Space Monitor excels at that particular task. Design-wise, it's the best-looking solution for those wanting to declutter their desks.

Even so, the Space Monitor doesn't entirely convince. Image quality leaves much to be desired, which is a shame given the obvious designer-leanings of the monitor's appearance. That's not to say the Samsung Space Monitor fails entirely, just that it's aimed at a limited group of individuals: not those seeking the best image quality, nor the fastest gaming panel, but those whose sole desire is elegant minimalism.

*Christopher Minasians*

### SPECIFICATIONS

SCREEN SIZE 32in • RESOLUTION 3,840x2,160 •  
SCREEN TECHNOLOGY VA • REFRESH RATE 60Hz •  
VIDEO INPUTS HDMI, mini DisplayPort • WARRANTY  
Two years RTB • DETAILS [www.samsung.com](http://www.samsung.com) •  
PART CODE LS32R750UEUXEN

#### CONNECTION PORTS

HDMI



Mini DisplayPort





## OVER-EAR BLUETOOTH HEADPHONES

### LINDY BNX-100

COMPUTER  
SHOPPER  
RECOMMENDED



£110 • From [www.amazon.co.uk](http://www.amazon.co.uk)

#### VERDICT

Multiple improvements over the preceding BNX-60 make these our favourite low-cost ANC headphones

**LINDY'S BNX-60 HEADPHONES** (*Shopper 341*) have proven hugely popular, and for good reason: £80 for a set of great-sounding, active noise-cancelling (ANC), Bluetooth over-ears is a tremendous deal. That's still true today, three years after release, and so the new BNX-100 aren't a replacement so much as a more fashionable, feature-rich spin-off.

This means a higher price as well, but only modestly, and it does buy you a cleaner, more elegant design than that of the BNX-60. The textured leatherette on the exterior of the drivers' housing calls to mind the premium look of Sony's discontinued MDR-1000X headphones, but it's tougher and much less prone to scratching.

There are plenty of other upmarket touches, too. The metal headband is sturdy, the inner red lining is elegant, and both the tough plastic casing and driver construction feel like they're built to last. Even the included carrying case has a touch of class, with a soft spandex-like material underneath and a leatherette finish on top.

#### IN THE ROUND

There are a few missteps, however. While the circular cups look stylish, they didn't fit over our ears as snugly as the oval-shaped pads of the BNX-60. They've also got a strong clamp force, which we found made them rather uncomfortable to wear for extended periods, especially while wearing glasses. In addition, although the drivers still swivel, it's a little disappointing that the headphones don't fold; many cheaper alternatives are easier to tuck away in a rucksack.

Three discreet buttons on the right cup provide media controls, with the central power button also serving as a means to answer calls.

There's also a 3.5mm auxiliary input, and using a wired connection automatically disables Bluetooth, thoughtfully conserving your battery.

On the left cup, meanwhile, is a Micro USB charging port, a switch for turning ANC on and off, and an audio passthrough button. This instantly reduces the volume of your music to 10%, so you can quickly tune into your surroundings. Note that this only works when ANC is switched on.

The final clever feature is one you can't actually see: a set of internal sensors enable the BNX-100 to automatically pause playback when they're taken off your head, and instantaneously resume it when they're back on. This only works over Bluetooth, but it's supremely convenient and a nice addition to such an affordable pair of headphones.

Battery life, naturally, depends on which features you're using. If you're listening over a wired connection with ANC enabled, you can expect around 30 hours of use between charges, while using ANC over Bluetooth will give you closer to 12 hours. Four blue LEDs on the exterior part of the left cup give an indication of remaining battery life, meaning you can see at a glance when a top-up is in order. It's just a pity that the illumination can't be disabled – and that goes for the power LED on the right cup, too.

Once it's time to recharge, the headphones take around two hours to fully refuel. There's no fast-charging option, and it's slightly annoying that they can't be used while they're being charged.

#### CARRY A TUNE

When paired with a compatible sound source, the BNX-100 support aptX, a compression system that delivers higher-quality audio over Bluetooth than the more common AAC and SBC codecs. This helps them shine throughout the frequency range, and gives them a fun sound signature, which is reminiscent of the BNX-60 but with a more aggressive approach and clearer mids. Lindy has also tweaked the highs, with the BNX-100 extending slightly further than its cheaper counterpart.

The difference between the two is noticeable. On the BNX-60, vocals sound



more restrained and a touch crowded by the instrumentation. The BNX-100 sound a tad airier and give a punchier, faster-paced delivery overall.

Instrument separation is good, too, and the BNX-100 manage to deliver a wider sound, creating an engaging listening experience. The only cause for concern is an inherited weakness from the BNX-60: slightly uncontrolled mid-bass performance, and sub-bass that doesn't extend quite as fully as we'd like.

In addition to a souped-up sound, the BNX-100 also feature improved ANC. Even though the cups don't form as tight a seal as those on the BNX-60, we found the newer headphones did a slightly better job of cancelling high frequencies. Neither model will silence all external sound – certainly not to the extent that Sony's or Bose's flagship models manage – but overall they did an impressive job of blocking out ambient noise without noticeably interfering with the music. You won't do better at this price point.

#### HEARING AID

Ultimately, the BNX-100 improve on the BNX-60 in almost every way. You might expect nothing less, given the higher price, but a £30 premium isn't that hard to swallow. Besides, you're getting a far more stylish design, a more refined sound, better ANC and that handy auto-pause feature.

*Christopher Minasians*

#### SPECIFICATIONS

HEADPHONES SUBTYPE Over-ear • PLUG TYPE 3.5mm • WEIGHT 541g • CABLE LENGTH 1.5m • WARRANTY One year RTB • DETAILS [www.lindy.co.uk](http://www.lindy.co.uk) • PART CODE 73140







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## IN-EAR BLUETOOTH HEADPHONES

# ONEPLUS Bullets Wireless 2

COMPUTER  
SHOPPER  
RECOMMENDED



£99 • From [www.oneplus.com/uk](http://www.oneplus.com/uk)

### VERDICT

The Bullets Wireless 2 look almost identical to their predecessors, but sound far superior

**ONEPLUS MADE ITS** name in smartphones, but last year saw the company venture into the headphones market with its Bullets Wireless earbuds. These had an alluring design and an affordable price, but were let down by lacklustre drivers.

Now OnePlus is back for another try with the Bullets Wireless 2. Can these new headphones fix their predecessors' problems and win over audiophiles on a budget?

### SECOND SHOT

Design-wise, the Bullets Wireless 2 have a lot in common with the original Bullets. The wired-together format, with its rubberised neckband, will suit commuters and office workers, although it doesn't work well with a high-collar jacket. It's not ideal for fitness fans either, but splash and water resistance means they should survive a bit of rain or sweat.

The finish and controls are very similar, too. The dark grey aluminium housing keeps its red accents, with the earphone nozzles set at a 45° angle. On the left side of the cable, an inline three-button remote can be used to control your media and answer calls. A USB Type-C charging port is set into the left side of the neckband, along with a multifunctional power button.

One last familiar feature is Magnetic Control. Once again, OnePlus has embedded magnets inside the outer housing of the drivers, allowing them to snap tightly together. This not only makes them convenient to stow away, but it also doubles as an instantaneous power toggle. Pull them apart to turn them on, and clip them back together to turn them off: it's that simple.

Battery life is average, with the earphones lasting around eight hours on a single charge. However, it's also possible to apply a quick flash charge, with 10 minutes of charging providing around five hours of playback. It's perfect if you're getting ready to head out the door and realise your headphones are dead.

Connectivity is one area where the Bullets Wireless 2 improve on the original model. They paired instantly with a smartphone over Bluetooth, and alongside the SBC and aptX codecs, there's now support for aptX HD, for even better transmission quality.

If you hold down the button on the left side of the neckband, you can pair the Bullets Wireless 2 with an additional secondary source, and if you've already paired the earphones with another device, they'll instantaneously switch to it. That's the theory, anyway; in practice, we couldn't get the headphones to automatically switch between a MacBook Air, a Surface Go and an Honor View 20 smartphone, but it will work fine with modern OnePlus phones.

Once you've got a connection, wireless performance is generally good. At one point we found the Bullets Wireless 2 had randomly disconnected, but turning them off and on again cleared this up. A bigger irritation is the overly loud high-pitched tone that beeps in your ear when you power on the headphones or try to switch the source.

### THREE FOR ALL

As well as the upgraded codec support, the Bullets Wireless 2 feature a hybrid triple-driver setup in each ear, which is a definite step up from last year's single 9.2mm dynamic drivers. As a result, the Bullets Wireless 2 sound far superior to their predecessors, with a meatier sound signature and better tonality across the frequency range.

The improvement is particularly noticeable at the lower end. The mid-bass frequencies

are far better controlled than with the Bullets

Wireless, which sound wobbly in comparison.

The bass also hits harder than some rivals, such as

SoundMagic's E11BT, although compared to the beefy 1More Triple Driver BT, the OnePlus buds lack a touch of finesse.

The lower mid-range is excellent, too. There's a bit of a dip in presence, but vocal tracks featuring rich instrumental sounds are vibrantly brought to life.

The highs extend well, with plenty of energy and sparkle, and a lovely wide, clear soundstage. It's not quite as engaging as the sound of the Creative Outlier Air (Shopper 377), which manage to separate the instruments in Enrique Iglesias's *Bailamos* flawlessly, but it's still a great performance.

The Bullets Wireless 2's biggest sonic weakness is a dip in the upper mid-range: this area of the spectrum lacks presence and just sounds a bit odd. This doesn't come as a huge surprise, as hybrid earphones often struggle with the crossover frequencies between drivers, something that isn't an issue with single-driver earphones.

### ARMS RACE

Regardless, the OnePlus Bullets Wireless 2 are a solid improvement on their predecessors. The feature upgrades are welcome, and the enhanced drivers and codec support make a big difference to sound quality. They're definitely worth the £30 price bump on the original earbuds.

They're not flawless, to be sure. The design won't suit everyone, the loud audio tones are annoying, and rival sets from 1More, SoundMagic and Creative give them a run for their money. If, however, you're looking for an upgrade over the original set or you own a OnePlus smartphone, the Bullets Wireless 2 are a great choice.

Christopher Minasians

### SPECIFICATIONS

HEADPHONES SUBTYPE In-ear • PLUG TYPE None •  
WEIGHT 24g • CABLE LENGTH N/A • WARRANTY One year  
RTB • DETAILS [www.oneplus.com/uk](http://www.oneplus.com/uk) • PART CODE Bullets  
Wireless 2



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## MEDIA STREAMER

# NOW TV Smart Box with 4K and Voice Search



£50 • From [www.argos.com](http://www.argos.com)

### VERDICT

Sky content is still only 720p, but this new Now TV Smart Box makes up for it with flexibility and features



**NOW TV BOXES** have long been a great way to watch Sky's exclusive TV shows and sport content without having to commit to expensive, long-term contracts. And, because they also act as media streamers from other third-party sources, they're a cheap tool for adding smart functionality to an older TV.

This latest model retains the voice control feature from the previous Smart Box, while finally adding support for 4K playback at up to 60fps. Weirdly, this doesn't cover Sky's own content: only the Netflix and YouTube apps can use this higher resolution. For Sky Sports, Sky Movies and the like, you're stuck with the same old (and disappointingly low) 720p resolution of older Smart Boxes, while other non-Sky streamed content goes up to 1080p.

It's fitting, then, that the Smart Box with 4K and Voice Search is similar on the outside, too. Its design is elegant enough to sit in a living room, but the glossy black plastic isn't particularly exciting. The box measures 125mm in length and width, is 21mm tall and is lightweight at 222g. There's a small white LED at the front, which remains lit when used and turns off when the device is in standby.

At the back is an HDMI 2.0 port, an Ethernet socket, a microSD card slot and a DC power connector. The microSD card slot is a nice inclusion: it opens the potential of having far more space to store downloaded apps.

### QUICK WITTED

Although you get HDR10 support, the Smart Box doesn't support Dolby Vision, HLG or HDR10+. On the audio front, there's Dolby Digital Plus and DTS surround but not Dolby Atmos or DTS:X. It works with both 5.1 and 7.1 pass-through, so if you've got the appropriate sound system or soundbar, you'll enjoy your movies and shows in superior surround sound.

Setting everything up is straightforward and fast: it took us just under 10 minutes, and much of that was spent waiting for updates to download and install. Once the Smart Box is ready to go, the interface feels intuitive, and the effectiveness of voice search is impressive. The microphone (hidden within the remote control) accurately picked up actor names, film titles and TV shows, while the software always found what we were looking for.

### CARE PACKAGE

As with previous Smart Boxes, content is accessed by buying passes: there's one each for Entertainment, Cinema, Kids, Sky Sports

My5 and Vimeo – and, as mentioned, you can stream 4K content via Netflix or YouTube.

The big catch to the Smart Box is that content in the Sky Sports, Cinema and Entertainment passes – in other words, the content you're paying extra to watch – is still limited to 720p. Although Sky has promised an upgrade to Full HD streaming by the end of the year, it has yet to confirm whether it will be charging extra for the service. There's also no antenna connection, as there was on the old Now TV Smart Box, so you can no longer watch Freeview channels.

The good news is that you can still pause and rewind live TV by up to 30 minutes, and

## The big catch is that content in the Sky Sports, Cinema and Entertainment passes is still limited to 720p

and the reality-show service Hayu. This might sound limiting if you're used to media streamers that provide instant access to everything, but if you're only interested in certain content and genres, then this system can work out as the cheapest way of watching premium TV and movies. A monthly Sky Sports subscription, for instance, would cost you £47 with Sky Q but just £34 on Now TV. Daily and weekly passes are available, too. We only wish it were possible to combine packages for a better deal. There are no bundle offers, so if you want to mix and match passes, be prepared to pay full price for every single one.

Regardless of which pass you opt for, there's plenty of content to sink your teeth into. And even without the passes, you can access a broad selection of streaming services including BBC iPlayer, ITV Hub, All 4,

at least other content isn't forced down to such a low resolution.

### REACH FOR THE SKY

If you're looking for a 4K streamer, this latest Now TV Smart Box is a decent option rather than an essential purchase. The Roku Streaming Stick+, Google Chromecast Ultra and Amazon Fire TV all offer a greater breadth of support for third-party apps and content and, in some cases, have a greater selection of features.

What makes Now TV viable, even in the face of these alternatives, is how it makes Sky content more accessible and affordable than getting a traditional TV subscription. That you can choose exactly which channels you want means you're not paying for nearly as much irrelevant content, and it's particularly good if you only want to watch, say, a single team's games on Sky Sports. Approach the Smart Box like this, and you're getting a fairly good deal, especially with 4K Netflix and free streaming services thrown in.

*Christopher Minasians*



### SPECIFICATIONS

**VIDEO OUTPUTS** 1x HDMI • **NETWORKING** 802.11ac Wi-Fi  
**DIMENSIONS** 125x125x21mm • **STREAMING FORMATS** None • **INTERNET STREAMING SERVICES** Now TV, BBC iPlayer, ITV Hub, All 4, My5, Netflix, YouTube • **WARRANTY** One year RTB • **DETAILS** [www.nowtv.com](http://www.nowtv.com) • **PART CODE** Now TV Smart Box with 4K and Voice Search



**OLYMPUS**

**OM-D**  
**E-M1X**



Image credits: Chris Eyre-Walker & Fernando Marmolejo

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\* Based on the CIPA standard, within system cameras, E-M1X with M.Zuiko Digital ED 12-100mm F4.0 IS PRO: 7.5 EV compensation, as of 1/2019.



## E-READER

# AMAZON Kindle (2019)

COMPUTER  
SHOPPER

★★★★★

BEST BUY

£70 • From [www.amazon.co.uk](http://www.amazon.co.uk)

## VERDICT

The basic Kindle isn't so basic any more, gaining Bluetooth connectivity and a useful reading light

**FOR A LONG** time, the main argument against buying the basic Amazon Kindle was that, despite the low price, it was too simple. More specifically, it wasn't as well made as the Kindle Paperwhite (*Shopper 372*) and it had no built-in reading light.

With the arrival of the 2019 model, however, those issues have finally been sorted out: you can happily splash out £70 on Amazon's cheapest e-reader, safe in the knowledge that it does much more of what its pricier stablemates can do.

The front light isn't the only new feature, either. Amazon has also added Bluetooth and, along with it, the ability to download and listen to Audible audiobooks.

## AD HOC

On the outside, it's a lot more familiar. It has the 6in, 167ppi E-Ink touch display of previous Kindles. It's still available in black or white and it still hooks in seamlessly to Amazon's vast catalogue of ebooks, allowing you to search for and buy books on the device itself.

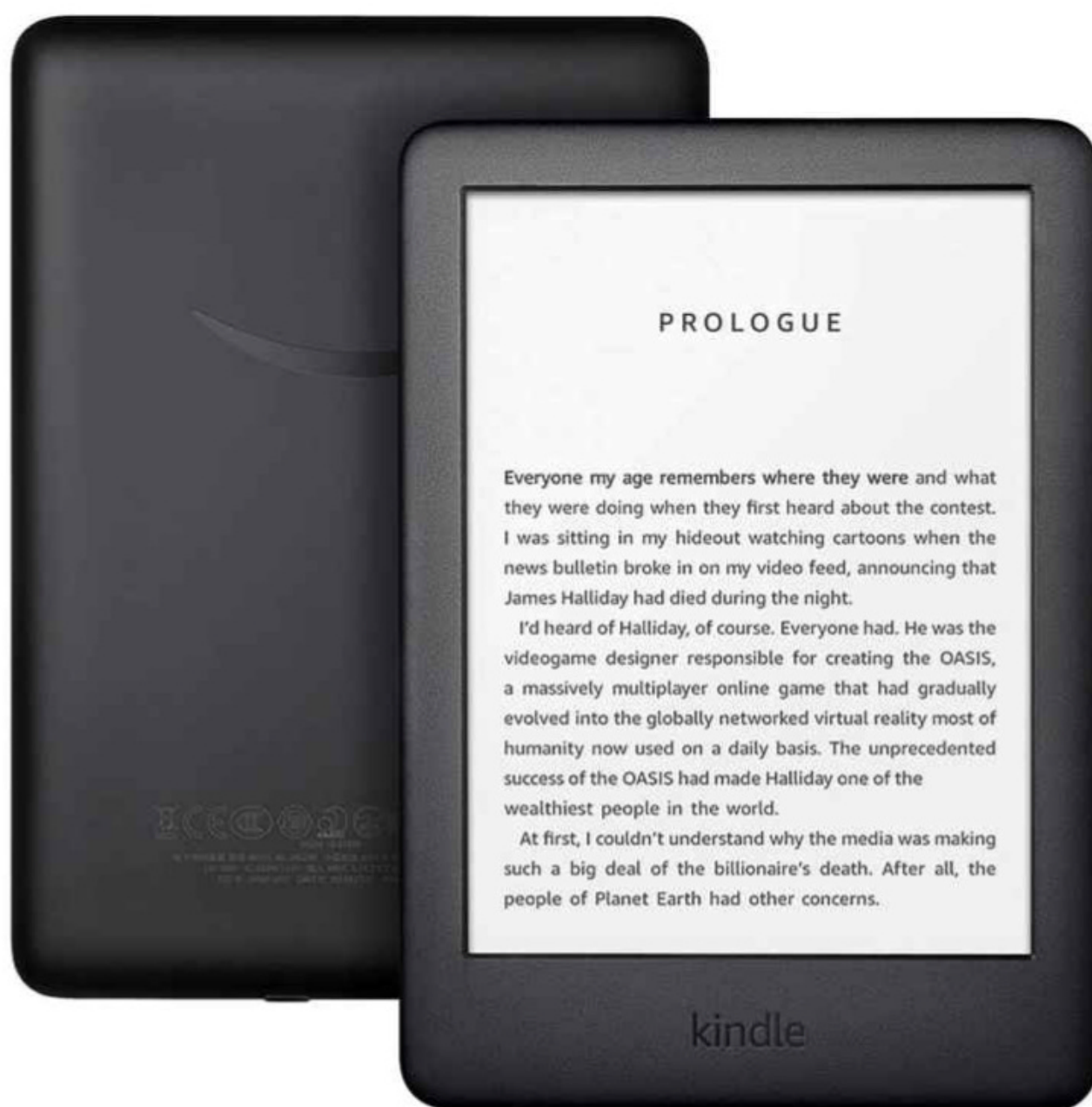
Like other Kindles, Amazon's latest e-reader is available in two different flavours: 'With special offers' and 'Without special offers'. Essentially, 'special offers' means adverts on the lockscreen, although these aren't particularly intrusive. With these enabled, the Kindle costs £70; if you want to remove the ads, it's £80.

At that price, the new Kindle has no significant rivals when it comes to value – not from other manufacturers, anyway. In fact, the only big rival manufacturer still selling dedicated e-readers is Kobo, whose recent products have all been focused firmly on the luxury end of the market, leaving Amazon to mop up in the budget sector.

The only real choice you have to make, then, is between the various models (with or without special offers) and buying the slightly more expensive Kindle Paperwhite (£120), which has more storage space, a crisper display and a slightly sleeker design.

The good news is that the basic Kindle is no longer as cheap-feeling and plasticky as the previous-generation device. Sure, it isn't as nice to hold or to read on as the £230 Kindle Oasis (*Shopper 361*), but it gives the Paperwhite a run for its money.

The new Kindle is solidly made, light and comfortable to hold. The edges and front



bezels are a little more rounded than the old model, but otherwise it's a familiar design. The E-Ink screen dominates the front of the device, slightly inset to accommodate the infrared touch sensors, and this display is surrounded by quite broad bezels.

The only other significant physical features are the Micro USB port and power button located on the bottom edge. There's no headphone jack, which means if you want to listen to audiobooks on this Kindle, you'll have to connect a pair of headphones or a speaker to it via Bluetooth. You don't get physical buttons for turning the page, either, which might irk some. Still, turning pages by tapping either side of the screen or swiping across isn't a big deal.

## HOW ILLUMINATING

There aren't many differences between this basic Kindle and the slightly pricier Paperwhite, but those that do exist are significant. First up – and probably the biggest – is the display, which is lower in resolution on the basic Kindle, at a pixel density of 256ppi to the Paperwhite's 300ppi. This deficiency isn't night and day, but text on the cheaper Kindle is clearly a little less crisp and well defined than its more expensive sibling. Our eyes were more comfortable with the Paperwhite's sharper text.

Another difference is that the front light consists of four LEDs rather than the Paperwhite's five. This is less of a deal breaker: the light on the Kindle is just as consistent as the Paperwhite's, with no discernible bright or dark patches. Unlike the Paperwhite, it's not IPX8 waterproof or

available with cellular connectivity but, again, these aren't serious shortcomings unless you read a lot in the bath.

Perhaps more of an issue is that there's half the storage inside the regular Kindle (4GB) than there is in the cheapest Paperwhite (8GB). This won't be a problem if you stick with text-based books, but if you plan on using it to download and listen to audiobooks regularly, you'll quickly chomp through that amount of storage.

It's also somewhat disappointing that Amazon still hasn't found a place in its current range of e-readers for a blue-light-reduction system, like that of the Kobo Forma (*Shopper 375*). There's also no ambient light sensor, which would have been preferable to having to change the display brightness manually.

## WELL READ

Nonetheless, the new Kindle does the job admirably and, if you've used a Kindle before, you'll be right at home with this new model. The software is no different from that of the most expensive Kindle Oasis, and Audible support grants this Kindle a flexibility previous versions didn't have. The addition of a front light and Bluetooth connectivity make it clearly the best-value Kindle in the range.

*Jonathan Bray*

## SPECIFICATIONS

SCREEN SIZE 6in • SCREEN RESOLUTION 256ppi •  
STORAGE 4GB • DIMENSIONS 160x113x8.7mm •  
WEIGHT 174g • WARRANTY One year RTB • DETAILS  
[www.amazon.co.uk](http://www.amazon.co.uk) • PART CODE Kindle (2019)



## ANDROID 8.0 SMARTPHONE

# SONY Xperia L3



£169 • From [www.amazon.co.uk](http://www.amazon.co.uk)

### VERDICT

As impressive as the Xperia 1 is, its budget sibling deserves some attention too

**DESPITE THE XPERIA** L3 acting as the budget component of Sony's 2019 Xperia line-up, this is no bargain-bin tat. It looks just like a flagship phone you'd be charged three times as much for – and it has a few hidden surprises, too.

Not that its entry-level status is entirely disguised, but the Xperia L3 certainly looks lovely. The all-metal unibody design is a pleasant surprise, and it fits nicely in the hand. There's also a side-mounted fingerprint sensor on the right edge, which can be used both for secure unlocking and for authorising contactless card payments via NFC. This sits between the phone's power button and volume rocker, while a single USB Type-C port can be found at the bottom.

The only thing not to like about the design is that the rear panel can be pressed inwards by about a millimetre. It's a cheap phone, sure, but give it a squeeze and it feels quite cheaply made. We also weren't initially fond of the awkwardly placed volume rocker sitting near the bottom of the phone, although this is a lot easier to get used to.

### TALL, BRIGHT AND HANDSOME

The Xperia L3 is fitted with an edge-to-edge 18:9 screen, with reasonably slim bezels above and below the display. The Gorilla Glass 5-coated screen measures 5.7in from corner to corner, with a 1,440x720 resolution. This isn't a high-resolution panel, nor should you expect it to be at this price, but it looks pretty enough.

In technical testing, we found that the Xperia L3's IPS panel was capable of producing 96% of the sRGB colour gamut, with an average delta-E of 2.32. For the most part, colours have plenty of pop across the palette, and the phone is also capable of reaching a sunlight-friendly maximum brightness of 504cd/m<sup>2</sup>. Likewise, a contrast ratio of 1,641:1 is very good for a phone at this price.

Powering the Xperia L3 is an octa-core 2GHz MediaTek MT6762 Helio P22, accompanied by 3GB of RAM and 32GB of eMMC flash storage. Unfortunately, we couldn't

get Geekbench 4 to run on the Xperia L3 – other reviewers have reported the same problem, indicating that Sony has blocked the software from running on its review sample units. That's a shame, as the Xperia L3 feels surprisingly sprightly in everyday use. The MT6762 is a budget chip, no question, but switching between multiple apps was a breeze, and we didn't encounter any slowdown issues when running CPU-intensive applications such as Google Maps.

### RUNNING TIME

Thankfully, our gaming benchmark managed to run without any problems. The GFXBench Manhattan onscreen test posted a result of 9.7fps, which means that the Xperia L3 is ideal for simple Android titles, but not high-fidelity 3D games.

The low-power CPU has a side benefit of merely sipping at the battery. That's if our video playback test is any indication: the Xperia L3 lasted for 15h 52m, which is a fine result. You shouldn't have any problems lasting a full day from a complete charge.

Lastly, the Xperia L3 is fitted with a dual-camera setup on the back of the phone, which is a pretty widespread arrangement these days. One of these is a standard 13-megapixel RGB lens with an aperture of f/2.2, while the other is a 2-megapixel depth-sensing unit, for fancy bokeh-effect portrait shots. An 8-megapixel selfie camera sits above the screen, complete with a face-smoothing beauty mode.

The Xperia L3 does a fair job at capturing detail-rich images in a variety of lighting conditions, with well-balanced exposures and accurate-looking colours. The phone's HDR mode lifts up shadowy areas

quite nicely without losing detail in overly bright areas of the image, while visual noise is kept to a minimum, even in low-light environments.

Speaking of which, the Xperia L3's rear-facing snapper does a much better job when the light is dimmed compared to the same scene captured with the similarly priced Moto G7 Play (Shopper 377). The Moto G7 Play's images came out rather soft and warm, while the Xperia L3's stills are nice and crisp.

The camera software could be better, however. It's a bit fiddly changing

through the camera settings, and the onscreen exposure and colour temperature sliders aren't labelled, which isn't ideal. There's no way to turn off HDR, either.

### SHAKE BELIEVE

This brings us to the Xperia L3's limited video capabilities. There's no frame rate adjustment – all recording resolutions are locked at 30fps – and the camera is only capable of recording video at a maximum resolution of Full HD. You won't find any form of image stabilisation, either, so footage is often jumpy, with visible screen tearing.

Still, while it might not be in the same league as its Xperia counterparts, Sony's Xperia L3 offers the ideal blend of usability and asking price. It's a dangerous line to tread, and we've seen a long list of budget-priced phones falter in recent years, but the Xperia L3 is a dependable choice for lighter wallets.

*Nathan Spendelow*



### SPECIFICATIONS

**PROCESSOR** Octa-core 2.2GHz MediaTek MT6762 Helio P22  
**SCREEN SIZE** 5.7in • **SCREEN RESOLUTION** 1,440x720 •  
**REAR CAMERAS** 13 megapixels, 8 megapixels • **STORAGE** 32GB • **WIRELESS DATA** 4G • **NFC** Yes • **DIMENSIONS** 154x72x8.9mm • **WEIGHT** 156g • **OPERATING SYSTEM** Android 8.0 • **WARRANTY** One year RTB • **DETAILS** [www.sonymobile.com](http://www.sonymobile.com) • **PART CODE** 1318-2748





## ANDROID 9.0 SMARTPHONE

# HUAWEI P30 Pro

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### VERDICT

A four-sensor camera array is just one of this gorgeous smartphone's many triumphs

**IT WASN'T TOO** long ago that you'd have been laughed out of the shops if you asked for a phone with multiple cameras, but now dual- and triple-lens arrangements are the new normal. Instrumental in this sea change was the Huawei P20 Pro (*Shopper 366*), which introduced triple-lens cameras to the masses, and now the P30 Pro aims to take smartphone photography even further with a snapper containing not three but four different sensors.

If it seems as though Huawei has only just released a flagship, you're not far off, as the Mate 20 Pro (*Shopper 373*) launched just six months ago. The P30 Pro complements the Mate series with a handful of extras, much as the Samsung Galaxy Note range expands on the Galaxy S formula, but there's at least one key similarity: the processor.

The Mate 20 Pro and P30 Pro are both powered by Huawei's own Kirin 980 mobile processor, which is a 7nm CPU clocked at up to 2.6GHz. In the P30 Pro, this is complemented by 8GB of RAM and a choice of 128GB or 512GB of expandable storage.

In addition, you're looking at a slightly bigger 6.5in OLED screen, with a resolution of 2,340x1,080, and a 4,200mAh battery. It's also running the latest version of Android, 9.0. There's the new camera setup as well, but we'll get to that in more detail later.

### OLD FRIEND

Outside of the cameras, the Huawei P30 Pro is a continuation of what made the Mate 20 Pro so great. It's achingly attractive, sandwiched between layers of softly curvaceous glass on the front and rear, and comes in some enticing, jewellery-shop colours. The most eye-catching is the iridescent 'Breathing Crystal' colour, which fades from deep purple to a light blue across the rear panel, depending on how the phone catches the light.

As you'd expect of a modern flagship, the Huawei P30 Pro is nice and thin, packing its large screen into a comparatively compact chassis. Better still, the P30 Pro's display delivers a slightly taller aspect ratio of 19.5:9.

Along with the arrival of this elongated aspect ratio comes the return of the notch. However, this time around it isn't an iPhone-like affair; instead, the 32-megapixel selfie camera is embedded in a comparatively unobtrusive circular teardrop notch.

### GOOD VIBES

From the pictures, you might be wondering where the front-mounted earpiece speaker went to. Unusually, you won't find such a thing on the P30 Pro. Instead, it has been replaced with a new feature Huawei calls 'electro-magnetic levitation'. This is a fancy way of saying the phone's screen vibrates to create sound when pressed against your ear. We're not sure where the levitation comes into it, or even if it's necessary, but it works well enough and cleans up the aesthetics a bit.

Odd features aside, the Huawei P30 Pro is the Huawei's most attractive, well-designed smartphone to date. It covers most of the functionality bases, too. There's a large 4,200mAh capacity battery keeping things ticking along, and it supports both fast 40W charging and reverse wireless charging, in effect turning it into a power bank. The P30 Pro is also IP68-rated for dust and water resistance.

On an unhappier note, 3.5mm headphone connectivity seems lost forever, but slightly more worrisome is the lack of microSD expansion. Instead, the P30 Pro, like the Mate 20 series, only supports Huawei's nano memory cards. These are physically smaller but more expensive than their micro-sized equivalents, and so make almost no sense whatsoever. Still, with at least 128GB of internal storage, you probably won't need one anyway.



Measuring 6.5in across the diagonal, the P30 Pro's screen is slightly larger than the 6.1in display of the cheaper P30 (*Shopper 377*). Its specifications remain the same, as the P30 Pro uses an AMOLED panel yet again and the resolution is 2,340x1,080. This would appear to be a downgrade on the 1440p display offered by the Mate 20 Pro, but this lower-resolution screen has the added benefit of prolonged battery life.

Display quality is pretty good, too. In the Normal display profile, the P30 Pro's screen is reasonably colour-accurate and able to reproduce 95.7% of the sRGB colour gamut with a total volume of 109%. An average delta-E of 2.53 isn't perfect, however, and there are a couple of issues, particularly with oversaturated red and dark blue colour tones.

Still, the P30 Pro's screen is capable of reaching a peak luminance of 854cd/m<sup>2</sup> in auto-brightness mode and, with this being an OLED panel, contrast is effectively perfect.

### GO LONG

We've already seen the Kirin 980 tear through our performance benchmarks in the P30 and the Mate 20 Pro, and the P30 Pro is no different. In the Geekbench 4 single-core and multicore tests, the P30 Pro produced scores of 3,302 and 9,720 respectively. Gaming performance is just as good, with the P30 Pro reaching a practically perfect average frame rate of 59fps in the GFXBench GL Manhattan 3.0 onscreen GPU benchmark.

Likely due to the move to a more efficient 7nm processor, overall battery life has seen a significant improvement from the P20 Pro. Our video rundown test shows that the P30 Pro's stamina is roughly 39% better than its predecessor, reaching a staggering total of 21h





22m before its 4,300mAh capacity battery was depleted. You shouldn't have any problems trying to squeeze out two days' use on a single charge.

### QUAD'S SAKE

Of course, the Huawei P30 Pro's star feature isn't the processor, its battery life or even the swish design, but the quadruple Leica camera array.

The primary sensor is an optically stabilised 40-megapixel unit with a wide aperture of f/1.6. What's special here is that, rather than using an RGB Bayer filter on top of the sensor to capture in full colour, this camera employs the less commonly used RYB filter, replacing the green elements of the filter with yellow.

Huawei calls this SuperSpectrum imaging, and it supposedly makes the camera more capable of capturing a broader spectrum of light. Huawei says the P30 Pro should be better equipped for low-light environments as a result.

This approach does have some potential drawbacks, however. A 2016 study by the Society for Imaging Science and Technology suggests that, while an RYB-based sensor can capture a broader spectrum of light, it may also be more susceptible to chroma flare and noise. This isn't something we've noticed after giving it a proper stress test, however.

As for video, the P30 Pro can record a maximum 4K resolution at 30fps, but you'll only be able to record at a silky-smooth 60fps if you drop the resolution to 1080p. Both optical and electronic image stabilisation are enabled by default in video for super-stable looking shots (Huawei calls this AIS). Slightly less useful, and a lot more gimmicky, is the addition of a new, 'dual-view' video recording mode, which allows you to capture footage using any two of the phone's rear cameras simultaneously.

Image quality is as good as the Mate 20 Pro, if not better in some instances. In both good light and poor, the P30 Pro is capable of capturing truly exceptional pictures, filled to the brim with detail and bright, vibrant colours that appear to pop right out of the screen.

Although there's a slightly noticeable delay when switching between cameras, the multiple shooting modes all work very well. The 5x zoom, for instance, is ideal for creeping into the background of an image, handy for amateur wildlife photography or shooting dramatic skylines.

The hardware is great, then, but the same can't be said about Huawei's fiddly camera app. It's overly complex and can be an incredibly convoluted and confusing experience. If you want to access the wide-angle and zoom shooting

## In both good light and poor, the P30 Pro is capable of capturing truly exceptional pictures, filled to the brim with detail

The main camera is accompanied by a new 20-megapixel, ultra-wide sensor, which shoots at a slightly wider angle than the Mate 20 Pro's equivalent, allowing you to capture even more dramatic vistas.

The P30 Pro has also seen an upgrade to its camera zoom capabilities. This time around you'll find an 8-megapixel, f/3.4 unit with up to 5x optical zoom – a big upgrade on the P20 Pro's 3x zoom. Huawei has achieved this by using a periscope-style housing, tilting the camera on its side and capturing the image via a tiny mirror. This is why, if you look closely enough, this third camera is square in appearance, not circular.

The fourth component isn't so much a camera lens as a ToF (Time of Flight) sensor, like that of the Oppo RX17 Pro (Shopper 375). This consists of two parts: an emitter that sends out beams of infrared light, and a receiver that monitors how quickly the light is reflected back to the sensor. Essentially, it's a more precise method of measuring depth than the usual stereoscopic technique used by most smartphones today.

The ToF sensor admittedly doesn't produce any major benefits to stills photography or even video footage, although in theory it should enable more precisely cut out portrait images. What Huawei aims to do with it is to improve the phone's augmented reality (AR) measurement features, meaning you should be able to measure distances, volumes and area to an increased 98% accuracy. These features won't be available at launch; instead, Huawei says they'll be enabled in a future software update.

modes, for instance, you have to switch from the phone's maximum 40-megapixel shooting resolution to 10 megapixels and tediously cycle through each mode. There's nothing in the camera software that tells you this beforehand.

### GREATNESS AT HAND

It might not look as if much has changed on the surface, but dig a little deeper and you'll find a smorgasbord of big changes that go a long way towards justifying the high price. There's an awful lot of substance to the P30 Pro and, while time will tell whether its quadruple camera array has the same long-lasting appeal as its predecessor, the P30 Pro's wide-ranging photographic capabilities are simply the icing on the cake of perhaps the most well-rounded flagship to date.

Sure, its high-end rivals are plentiful – and in some cases do things slightly better in key areas – but Huawei's elegant P30 Pro represents the very pinnacle of smartphone design.

*Nathan Spendelow*

### SPECIFICATIONS

**PROCESSOR** Octa-core 2.6GHz Kirin 980 • **SCREEN SIZE** 6.5in • **SCREEN RESOLUTION** 2,340x1,080 • **REAR CAMERA** 40 megapixels, 24 megapixels, 8 megapixels, ToF sensor • **STORAGE** 128GB • **WIRELESS DATA** 4G • **NFC** Yes • **DIMENSIONS** 158x73x8.4mm • **WEIGHT** 192g • **PART CODE** 51093RKU

Battery life



See page 110 for performance details



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# GOOGLE Pixel 3a



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## VERDICT

Google returns to more affordable handsets with the brilliant Pixel 3a

**GOOGLE'S LATEST PHONES** are both a departure and a throwback. The Pixel 3a and Pixel 3a XL are lower-specced, mid-range equivalents of the Pixel 3 and Pixel 3 XL (*Shopper 372*), themselves members of a product family that has exclusively dabbled in the high-end. At the same time, the concept of competitive hardware at a lower price evokes the Pixel brand's precursor, Nexus.

There's a lot to be excited about here. The £399 Pixel 3a is £180 cheaper than the Pixel 3, yet it looks identical, uses the same clean Android UI and, crucially, has a largely identical rear camera. The main differences are that the Pixel 3a houses a slower Snapdragon 670 processor, and lacks the waterproofing of its premium brethren.

## NEW DUDS

Other differences are similarly well hidden. For instance, the Pixel 3a shares the Pixel 3 family's two-tone casing design, with a smoother section at the top softening to a grippier, silky matt finish towards the bottom, although here, it's built from polycarbonate plastic, not glass and aluminium.

Not that this leads to a cheap-feeling device. The Pixel 3a is a delight to hold and use, fitting comfortably in the palm of your hand. Google's circular fingerprint reader sits in the same location on the back of the phone, and there's a USB Type-C charging port on the bottom, flanked by a pair of speaker grilles.

It's a genuine shame to lose waterproofing, however, and such cost-cutting also means there's no Corning Gorilla Glass protecting the display. Instead, Google has opted for Dragontail glass, a cheaper but softer (and thus less scratch-resistant) alternative. The switch from a glass back panel to a plastic one has also forced out wireless charging support, although there is a much more welcome difference in the 3.5mm headphone jack. Google's flagships haven't included these since the original Pixel.

Besides measuring an extra 0.1in diagonally, the Pixel 3a's display is largely unchanged from the Pixel 3. This is a lovely-looking 2,220x1,080 OLED panel, with a pin-sharp pixel density of 441ppi. There are three display modes to choose from, with the Natural screen

profile being the most colour-accurate. According to our colour calibrator, we found that it covered an excellent 95.9% of the sRGB colour gamut, with an impressive average delta-E of 0.91. The Boosted and Adaptive modes both tend to oversaturate colours.

Brightness isn't too shabby, either. The Pixel 3a is capable of hitting a peak luminance of 416cd/m<sup>2</sup>, meaning it's perfectly readable in all but the brightest conditions, even if it's a long way behind Samsung's dazzlingly bright OLED panels. A perfect contrast ratio of infinity:1 also helps readability.

## DRAGON HEELS

The Pixel 3a comes equipped with Qualcomm's newest mid-range chip, the octa-core Snapdragon 670. This is a 10nm architecture CPU with a clock speed of 2GHz, so you can't expect the performance of the Pixel 3's Snapdragon 845, which hit a blazingly fast 2.8GHz. In other respects, however, it's much the same, with 4GB of RAM and 64GB of internal storage.

The good news is that this CPU downgrade hasn't simply produced a slow smartphone. With Geekbench 4 scores of 1,619 in the single-core test and 5,146 in the multicore test, the Pixel 3a is expectedly behind the Pixel 3, but still a capable runner. Subjectively, the Pixel 3a doesn't feel noticeably slower in normal use.

Gaming performance takes a more tangible hit, as the Pixel 3a's GFXBench Manhattan 3 onscreen score of 27fps is under half of the Pixel 3's 60fps. Most games are still playable, however, and can even default to higher graphical settings.

The Pixel 3a's battery has also increased in size to 3,000mAh. That's only slightly bigger than the battery in the regular Pixel 3, but when you add the not-so-power-hungry



Snapdragon 670 into the mix, you get a phone that lasts quite a bit longer on a single charge. The Pixel 3a lasted 15h 7m in our looping video test, up considerably from the Pixel 3's 12h 22m.

The rear camera was easily the best thing about the Pixel 3: a single-lens system that nonetheless stood among the very best dual- and triple-lens shooters. It's encouraging, therefore, to see the same 12.2-megapixel lens trickle down to the Pixel 3a, with the wide f/1.8 aperture,

dual-pixel focus and optical image stabilisation all included. The only difference is the lack of Google's Pixel Visual Core add-on, an additional processor that improves the quality of HDR and low-light images.

Everything else is identical, and the most discerning of eyeballs will struggle to tell apart images shot by the two phones. No matter the lighting conditions, photos look terrific, with superb dynamic range and a pleasingly neutral colour palette. Google's Night Sight shooting mode impresses again when it comes to low-light photography, using AI to illuminate shots in the same way as the flash.

## A FOR EFFORT

Judging by the Pixel 3a, Google's return to the mid-range is a bold yet highly successful move. While Huawei's Lite-branded substitutes of its P and Mate series smartphones are filled with compromises and cutbacks, the Pixel 3a delivers a remarkably similar top-shelf experience as its flagship counterpart, but with a softer impact on your wallet.

*Nathan Spendelow*



## SPECIFICATIONS

**PROCESSOR** Octa-core 2GHz Qualcomm Snapdragon 670 • **SCREEN SIZE** 5.6in • **SCREEN RESOLUTION** 2,220x1,080 • **REAR CAMERA** 12.2 megapixels • **STORAGE** 64GB • **WIRELESS DATA** 4G • **NFC** Yes • **DIMENSIONS** 151x70x8.2mm • **WEIGHT** 147g • **OPERATING SYSTEM** Android 9.0 • **WARRANTY** One year RTB • **DETAILS** [store.google.com](http://store.google.com) • **PART CODE** Pixel 3a





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### VERDICT

In this successful attempt at a more affordable Versa, Fitbit has made snips in mostly all the right places

**THE ORIGINAL FITBIT** Versa (*Shopper 365*) was distinguished by its versatility, so what happens when a cheaper version comes along that jettisons features to hit a lower price?

The answer isn't as grim as it could have been. The Fitbit Versa Lite makes a few cuts, but not to anything that was essential to the original Versa's success, and buys itself a £50 price difference in the process.

### THE DAY THE MUSIC DIED

The first thing to go is onboard music support, mainly in the loss of Deezer. This is arguably the least significant of the cuts, as since neither this nor the original Versa have built-in GPS, you're most often going to be using it together with a smartphone, which can be your music playback device, too. You can still control music from the Versa Lite, just not have the songs stored on the watch itself.

Second, it loses support for Fitbit Coach's onscreen workouts, presumably because of the lack of internal space. That's more of a shame, although given it was a subscription service anyway, it's not a huge loss either.

Third, it loses the Versa's NFC chip and Fitbit Pay app. This is less of a worry in the UK than it would be in, say, the US: only a couple of smaller banks support Fitbit Pay, so most users won't be missing out on anything.

The fourth and only major loss is the Versa's altimeter, meaning it can't count the number of floors you've climbed. It also doesn't have the three-axis gyroscope, so it won't track laps when you're swimming, although you're still free to take it in the pool for time-keeping purposes, as it maintains the same 50m waterproofing.

Design-wise, the Fitbit Versa Lite is barely any different at a glance. It has the same slightly rounded square face and chamfered edges surrounding a bright, 300x300 touchscreen. Display colours are bright and vibrant, and the contrast is excellent.

However, if you were to make the slight downgrade from the original Fitbit Versa to the Versa Lite – perhaps taken in by

the new marina blue or mulberry colour schemes – you might initially be a touch confused. That's because Fitbit has reduced the number of buttons from three to just the one on the left-hand side.

The rest is all controlled by touchscreen. It's often worth being wary of any move to reduce physical buttons on a fitness tracker, because rain and sweat tends to make touchscreens unreliable at best, but at least it brings the Versa in line with the Fitbit Charge 3 and Inspire's single-button designs.

### POSITIVE TOUCH

In day-to-day use, the Fitbit Versa Lite is simply brilliant. The screen is just the right size to get all the data you need at a glance, without looking bulky or awkward, and we didn't really miss the two buttons on the side

either. The touchscreen is responsive enough to serve you well for navigation and controls.

Notifications come through with a reassuring buzz, and the built-in apps are easily accessible and sensibly thought out. Like the recent Fitbit Inspire HR (*Shopper 377*), breathing exercises are right there

on the watch, allowing you to take two or five minutes out of your day for some guided meditation: it's not all about the cardio, after all.

Speaking of cardio, this is a watch that is far better suited to running than the Inspire HR.

Although it doesn't

have any more features – both have heart-rate monitors and connected, rather than integrated, GPS – the screen shows a lot more useful data thanks to the extra size. Indeed, you can see two fixed stats (distance and pace by default), while a third data field lets you cycle through a list of other metrics at the touch of a button.



This is a very sensible design, and three data fields are probably enough for most people, although the more advanced running watches we've used, such as the Garmin Forerunner 235 (*Shopper 368*) and Polar Vantage M (*Shopper 375*), have space for four.

### ALRIGHT ON THE LITE

Piggybacking off the phone's GPS isn't as good as a built-in solution, of course, but the

The screen is just the right size to get all the data you need at a glance, without looking bulky or awkward



Versa Lite proved reasonably accurate in distance tracking; at the end of a precisely 5km run, it was only off by 130m.

Unfortunately, heart-rate tracking is all over the place. We wore both a chest strap and the Versa Lite during an extended exercise session, and while the strap data showed predictable increase over time, the Versa Lite's data showed no trend at all – just random-looking fluctuations. That's disappointing, although given the Versa Lite's price and the fact that heart-rate tracking isn't the most important thing in a running watch, it's also something we're willing to forgive.

The Versa Lite makes largely sensible cuts on its predecessor to ensure it's just as easy to recommend. Combined with the excellent Fitbit app and the community it brings, this is a wearable that's every bit worth its price.

Alan Martin

### SPECIFICATIONS

PEDOMETER Yes • HEART-RATE MONITOR Yes •  
DISPLAY SIZE 1.3in • RESOLUTION 300x300 •  
OS SUPPORT Android, iOS • BATTERY LIFE Five days •  
WARRANTY One year RTB • DETAILS [www.fitbit.com](http://www.fitbit.com) •  
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## MIRRORLESS CAMERA

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### VERDICT

By distilling features from the X-T3 into a smaller, lighter and cheaper body, the X-T30 is everything you need in a travel CSC

**FUJIFILM HAS WON** a lot of fans with its XT camera range, and deservedly so – its approach of applying the same features from more advanced models to cheaper cameras has produced some greats. Just as the X-T20 was a pared down X-T2, so the latest X-T30 is a baby X-T3 (*Shopper 375*).

Featuring many of the same specifications as its pricier big brother, which costs £1,699, the X-T30 is ideal as a travel camera, a backup camera for X-T3 owners or just an all-round good performer for those who don't want to push their budget too far.

With the same 26.1-million-pixel APS-C X-Trans CMOS sensor and X-Processor 4 combination as the X-T3, the X-T30 should be capable of delivering the goods, quality-wise. The APS-C sensor might be smaller than the full-frame chips in cameras such as the Nikon Z6 (*Shopper 377*) or Canon EOS R, but Fujifilm clearly believes this size of sensor is the perfect balance between portability and image quality: big enough to capture lots of light, but not requiring a huge body to house it.

Other similarities that the X-T30 shares with its sibling are its autofocus system and fast burst mode of up to 20fps. Where the X-T30 differs from the X-T3 is its buffer depth, offering a more limited 17 frames (Raw) before the camera needs to pause for a breather; the X-T3 shoots up to 79. If you're



from the 'spray and pray' school of action photography, this might not be the camera for you, but if your subjects tend to be more static, it's likely to be less of a bother.

### MINI THREE

Cameras in Fujifilm's range currently fall into one of two camps: there's the flatter 'rangefinder' style of the X-Pro series, and the more DSLR-like 'XT' style, which finds the viewfinder in the middle of the top plate. The X-T30 follows suit and is very much like a smaller X-T3 in shape.

While the X-T30 uses the same sensor and processor as its big brother, there are notable differences in its design. The X-T30 is smaller and lighter, which makes it great for travelling, but there are compromises. A good example is the lack of a dedicated ISO dial; another is its single SD card slot, which is unlikely to be a major problem for most enthusiasts, but for those who like to back up on the go, it's something to think about.

The good news is that there's still a number of direct access control dials and buttons to satisfy tactile users. There's a drive mode dial on the left of the top plate, while two more dials for shutter speed and exposure compensation are on the right. Something you won't see on the more advanced X-T3 is an 'auto' switch, but there's a big one on the X-T30 – good for those who want the camera to take over exposure with a flick of the finger.

### NO JOY

Buttons on the back of the camera are scarce. Our only major complaint is the positioning of the Q button, used to fire up the quick menu. It's on the rear thumb rest, and we found it extremely easy to accidentally push when looking through the viewfinder; it arguably would have made more sense to put it out of the way of wandering thumbs. The joystick is handy for moving the focus point around the frame, but again it's awkwardly placed. These are both issues that you're likely to learn to work with once you've been using the camera for a long period, however.

The X-T30's viewfinder is smaller and has a lower resolution than that of the X-T3 – 0.39in





to the X-T3's 0.5in, and 2.36 million pixels to the X-T3's 3.69 million. However, it's more than usable and, unless you're using an X-T3 at the same time, stands up well in isolation. It's joined by a 3in touchscreen that tilts up and down to help with slightly awkward angles, although unlike the X-T3's screen, it doesn't tilt outwards to help with portrait-format images. As with Canon's new EOS R and RP cameras, you can use the screen and viewfinder in tandem, moving your thumb across the screen to alter the focus point.

Another shared specification between the X-T3 and the X-T30 is the same phase detection autofocus system with 99% sensor area coverage, along with burst shooting speeds of up to 20fps. In practice, it's very capable of keeping up with reasonably predictable subjects, but a little less so with erratic or fast-moving subjects.

The X-T3's superior buffer depth, which allows it to take more than twice as many shots in a single burst than the X-T30, makes it the better choice for sports and action shooting. For the occasional fast-moving subject, however, the cheaper camera is a good little performer.

Finally, another specification that will appeal to travel shooters is the ability to charge via USB Type-C. That means there's no need to bother with dedicated chargers, and you can also use power banks to give the camera a boost while on the road.

### KEEN EYE

Just as the X-T20 shares the same sensor as the X-T2, the X-T30 uses the X-T3 sensor. We've already seen this in action from reviewing the original camera, and know just how well it can perform.

In short, image quality is fantastic. Fujifilm images are generally characterised by a filmic quality, with vibrant yet natural colours and great dynamic range. That remains true for the X-T30. It also works well in low light, and doesn't suffer too badly from having a smaller than full-frame sensor.

In extremely dark conditions, images shot at ISO 12,800 remain usable, with low noise and not too much evidence of image smoothing. Speeds beyond that are extension settings. Where light is low but not extremely so, you can just about push to ISO 25,600 if you're intending to share at small sizes and need to facilitate a quicker shutter speed. In an ideal world, you'll stick to ISO 3200 or below for the best image quality.

Focusing in most conditions is very swift and generally accurate. In very low light, the camera can hunt a little before it locks on to the target, but it's extremely rare for a false confirmation to be displayed, even if that means you have to give it a couple of goes to get there.

Using all-purpose metering resulted in well-balanced exposures in the majority of situations. JPEG images straight out of the camera are fantastic, but its Raw files are extremely malleable if you need to expose



for highlights and bring back some shadow detail in post-processing.

### STEADY ON

Film Simulation modes are a great bonus with Fujifilm series cameras. The X-T30 is equipped with a full range of options, including Provia (the default setting), Velvia, Astia, Classic Chrome and Acros (monochrome).

Not having image stabilisation in the body is a bit of a disappointment, however. Instead, you'll have to rely on quick shutter speeds, or work with lenses with stabilisation built in,

As we generally find to be the case with Fujifilm cameras, there's a lot to like about the X-T30 and hardly anything to dislike. It's a superb camera that distils many of the best elements of the X-T3 into a smaller, lighter and cheaper device.

### GRADE DEFLATION

That said, when compared to the last-generation X-T20, the differences are not huge enough to demand an immediate upgrade. In fact, it depends what you shoot: image quality is very similar to the old

## It's a superb camera that distils many of the best elements of the X-T3 into a smaller, lighter and cheaper device

such as the excellent 18-55mm f/2.8-4 kit lens. With impeccable sharpness and a wide maximum aperture, it's an ideal everyday lens. You can also buy the X-T30 with a 15-45mm kit lens, which is nice and small but doesn't perform quite as well.

There are plenty of other lenses available for X mount now that the system has matured since its debut in 2012. For the X-T30, the f2 primes make perfect sense: small and light, but still capable of producing excellent images. We've used the 23mm f/2 and the 50mm f/2 with this camera and found both to be the ideal match for its shape and size.

It's fair to say that the X-T30 is unlikely to be the first choice for serious videographers, but for those who like to create the odd movie, there's DCI 4K available in frame rates up to 30p. Standard 4K is also available up to 30p, too. Full HD, as well as Full HD slow-mo, is also present. You can use the X-T30's USB Type-C port to attach headphones, while there's also a microphone socket. You can still shoot LOG and output 10-bit video over the HDMI connection, but the X-T3's ability to shoot a wider range of frame rates, as well as displaying a film simulation while recording F-log footage, gives it an edge.

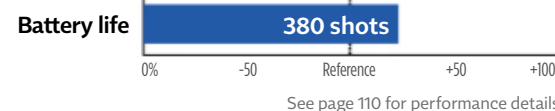
model, with improvements chiefly around autofocus and body design. If you primarily shoot static subjects, the X-T30 might not give you much over the X-T20.

It's also something to consider if you're trying to choose between the X-T30 and the more expensive X-T3. Consider what's important to you: for your extra cash, the X-T3 gives you an additional memory card slot, more body controls, a sideways tilting screen and a better burst depth. If you can live without all of those things, the X-T30 gives you the same image quality. For many, that will be more than enough.

Amy Davies

### SPECIFICATIONS

**SENSOR RESOLUTION** 26.1 megapixels • **SENSOR SIZE** 23.5x15.6mm (APS-C) • **FOCAL LENGTH MULTIPLIER** 1.5x • **VIEWFINDER** Electronic (2.36 million dots) • **LCD SCREEN** 3in (1.04 million dots) • **VIEWFINDER MAGNIFICATION (35mm-EQUIVALENT, COVERAGE)** 0.62x, 100% • **WEIGHT** 383g • **DIMENSIONS** 83x118x47mm • **WARRANTY** One year RTB • **DETAILS** [www.fujifilm.com](http://www.fujifilm.com) • **PART CODE** 16619982





## NINTENDO

## Labo VR Kit

COMPUTER  
SHOPPER  
BEST BUY

★★★★★

£70 • From [store.nintendo.co.uk](https://store.nintendo.co.uk)

## VERDICT

This buildable VR headset is the perfect accompaniment to your Nintendo Switch

**EVEN IF THE** build-it-yourself cardboard contraptions of Nintendo's Labo platform (*Shopper 366*) are now cluttering up your living room, the newest expansion kit might well be enough to rekindle your interest. Nintendo is finally re-entering the world of virtual reality with the aptly named Labo VR – a well-priced window into virtual reality that uses nothing but a Switch console, some folding card and just a little bit of sticky-backed plastic.

The Labo VR Kit is somewhat like Google Cardboard, and not just in the sense that it's literally built around deceased trees. Both systems make VR simpler and cheaper by placing an existing display in front of a set of goggles; with the Cardboard, it's your phone, with Labo VR, it's your Switch.

This particular package contains five different DIY models that affix to the Nintendo console, each one designed for a distinct set of mini games, from an on-rail tank shooter to an endearingly imaginative, physics-based puzzler in which you push around objects with an elephant's trunk. You can also make your own VR games with the surprisingly complex game creator software.

## HOUSE OF CARDBOARD

Like Nintendo's other Switch construction kits, what makes Labo VR so good is that it uses relatively simple construction materials in unique and interesting ways, each time creating a one-of-a-kind experience. The sorts of contraptions you create after just a couple of hours of simply folding cardboard and adding elastic bands are mind-blowing, filled with intriguing building techniques and fun features.

Thankfully, while some of the finished products might look rather complicated and intricate, Nintendo's



clear-to-follow instructions are terrific, providing many helpful tools to prevent you from getting stuck. Each step is detailed, allowing you to fast-forward and go back a few steps, with a 3D reconstruction of your current stage that can be viewable from multiple angles and zoomed with the Switch's right analog stick. The instructions are also filled with humour and colourful characters; a nice touch when you need to keep younger builders with short attention spans entertained.

Speaking of little hands, it's worth mentioning that you can also restrict the use of the VR mode for children under six years old (Nintendo recommends that VR is used

using, you might find yourself soaring above an island as a bird, competing to take the best underwater pictures, driving in a Thunderdome-like vehicular battle arena or simply feeding some hippos. Each game stands out from the last, and it's genuinely very enjoyable discovering what's on offer, finding out how these unique Labo kits that you've constructed take full advantage of these experiences.

Labo VR also enables the newly added VR modes in *Super Mario Odyssey* and *The Legend of Zelda: Breath of the Wild*, both killer apps for the Switch; you hold the headset with one hand and control the game through a single Joy-Con in your other. Don't

## Letting your inner child run free is a mantra that's been at the heart of everything Nintendo has done

only by players aged seven and above). Enable this and it prevents the Switch's screen from splitting into two separate lenses. This 2D mode still allows you to play the various mini games on offer, using the Switch's gyroscopic functionality, but without the VR-inducing headaches you might get from pushing the console's screen against your face.

The VR goggles – which consist of two circular lenses in a plastic housing, surrounded by cardboard – are very simple to build (taking roughly 30 minutes to complete) and slot nicely into the other, larger models.

The Switch itself fits nice and snug in the cardboard housing, and can be locked in place with some of the attachments for added peace of mind that it won't fall out and clatter to the floor.

## HEAVY BUILT

One thing that Labo VR has in common with Nintendo's first foray into VR, the ill-fated *Virtual Boy*, is that it can't be worn as a conventional headset – you need to hold everything up with your hands.

This can get tiring during long sessions, so it's lucky that the included mini games can be played in short bursts.

These games are both numerous and varied. Depending on which model you're

expect implementation quality to match the likes of the HTC Vive or Oculus Rift, however. For example, *Breath of the Wild* normally runs at 720p in handheld mode; in VR mode, this is split in half, so you're effectively seeing it at a heavily pixelated 360p for each eye.

## CREATIVE FORCE

Letting your inner child run free is a mantra that's been at the heart of everything Nintendo has done since the very beginning. With experiences that leave you grinning from ear to ear, Nintendo's family-friendly games whisk you away from the stresses of adult life, and the Labo VR is quite obviously a continuation of this legacy.

Most importantly, the sort of otherworldly adventures that Labo VR provides are unmatched. Not only do you construct these intricate creations from scratch, but you also get to use them as fun play things in-game. Even if there are far more powerful virtual reality platforms, with better AAA game catalogues, Labo VR is unique and quite often more fun than any of them.

Nathan Spenkelow

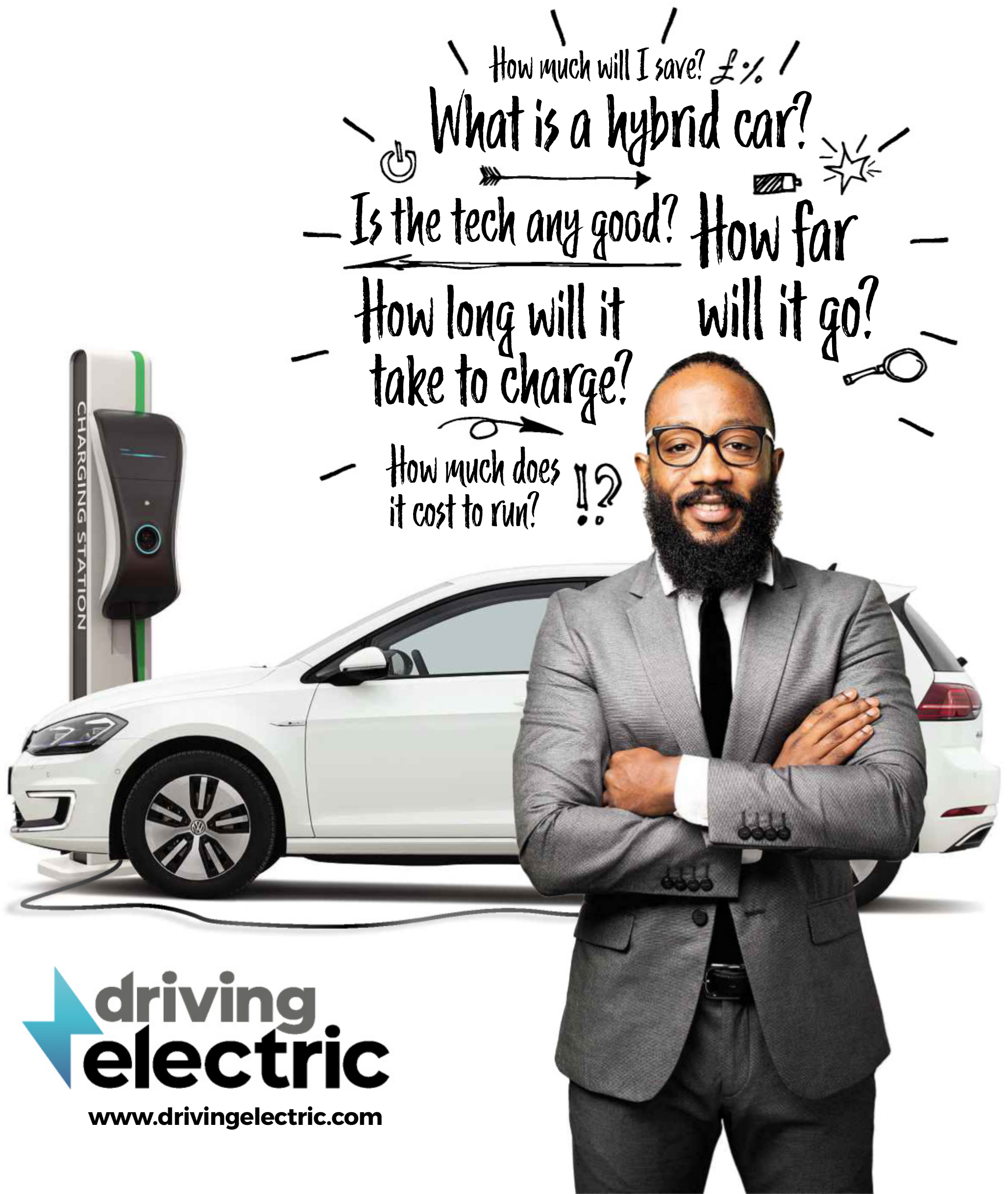


## SPECIFICATIONS

AVAILABLE FORMATS Nintendo Switch • HARD DISK  
SPACE Not stated • DETAILS [labo.nintendo.com](https://labo.nintendo.com) •  
PRODUCT CODE Nintendo Labo VR Kit



# All you need to know about electric cars...



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What is a hybrid car?

Is the tech any good? How far will it go?

How long will it take to charge?

How much does it cost to run? !?

CHARGING STATION



**driving electric**

[www.drivingelectric.com](http://www.drivingelectric.com)



# Choosing a... PC system

**01** A basic PC costing around £350 will be able to run everyday office, multimedia and education software and will easily cope with surfing the internet. It might even be able to run some modern games.

Many PCs can be sold either with or without a monitor. If you don't like the display the manufacturer is offering, you can always use your current one, or buy another one separately.

**02** If you want to play games, you'll have to upgrade the graphics card. Budget cards such as the Nvidia GeForce GTX 1050 will cope well with many 3D games, but to play the latest 3D games smoothly (and enjoy the best-quality graphics) it's worth upgrading to a more powerful card such as the Nvidia GeForce GTX 1070.

**03** All modern PCs come with at least a dual-core processor and are capable of most tasks. Anyone who regularly undertakes demanding tasks such as video editing and encoding should consider a hexa-core or even an octa-core processor.

**04** There are plenty of good reasons to upgrade the PC's memory or hard disk. If you'll use your PC for gaming, video editing or other demanding tasks, you'll need at least 8GB of RAM and a large hard disk; 1TB should suffice. Many new PCs have an SSD, which speeds up the time it takes for your PC to boot and for programs to load.

**05** Having plenty of USB ports is always useful, as most computer

peripherals attach to these ports. Most new PCs come with USB3 or the latest USB3.1 ports, which provide faster data transfers when used with supported devices than the older USB2 standard.

**06** Most new PCs now come with Windows 10 pre-installed. Don't be too easily swayed by the inclusion of other software, though, as it may be that you'll never use it.

**07** While most PCs come in cases of a similar size, some have more compact mini tower or mini PC cases. These smaller PCs will fit under your TV or on your desk more easily, but bear in mind that they're significantly harder to upgrade than full-size machines.

## PCs

### RASPBERRY PI

3 Model B+

★★★★★

£28 • [uk.rs-online.com](http://uk.rs-online.com)

**COMPUTER SHOPPER**  
BEST BUY

The ultimate micro PC gets even better

with faster CPU clock speeds and dramatically improved Wi-Fi performance. The differences between this and the standard Pi Model 3 probably won't be enough to be worth a direct upgrade, but since this is no more expensive, it's the best choice for new projects.

**PROCESSOR** Quad-core 1.4GHz Broadcom BCM2837 • **RAM** 1GB • **USB PORTS** 1x Micro USB (power), 4x USB2 • **TOTAL STORAGE** MicroSD card slot • **DISPLAY** None • **OPERATING SYSTEM** Raspbian • **WARRANTY** One year RTB • **DETAILS** [www.raspberrypi.org](http://www.raspberrypi.org) • **PART CODE** Pi 3 Model B+ • **FULL REVIEW** Jun 2018



### LENOVO IdeaCentre 620S

★★★★★

£579 • [www.currys.co.uk](http://www.currys.co.uk)

**COMPUTER SHOPPER**  
BEST BUY

Mini PCs can be overpriced, slow or even sold without RAM and storage, but the IdeaCentre 620S is a complete system that's both reasonably powerful and pleasantly affordable. The quad-core Intel Core i5-7400T handles office work well enough, while an Intel Optane Memory drive gives the hard disk a speed boost, and there's even a GeForce GTX 1050 Ti for extra graphical capability.

**PROCESSOR** Quad-core 2.4GHz Intel Core i5-7400T • **RAM** 8GB • **FRONT USB PORTS** None • **REAR USB PORTS** 4x USB3 • **TOTAL STORAGE** 1TB hard disk, 16GB Intel Optane Memory drive • **GRAPHICS CARD** 4GB Nvidia GeForce GTX 1050 Ti • **DISPLAY** None • **OPERATING SYSTEM** Windows 10 Home • **WARRANTY** One year RTB • **DETAILS** [www.lenovo.com](http://www.lenovo.com) • **PART CODE** 90HC0011UK • **FULL REVIEW** May 2018



### CHILLBLAST Fusion Ryzen 7 RTX 2070 Custom Gaming PC

★★★★★

£1,300 • [www.chillblast.com](http://www.chillblast.com)

**COMPUTER SHOPPER**  
RECOMMENDED

From its multithreading-friendly processor to its hulking Turing graphics card, this desktop has the hardware to breeze through all but the toughest 4K-resolution games. There's not as much room for internal upgrades as some mid-tower systems, but the Fusion Ryzen 7 RTX 2070 Custom Gaming PC makes up for this with high core performance and good pricing.

**PROCESSOR** Octa-core 3.2GHz AMD Ryzen 7 2700 • **RAM** 16GB • **FRONT USB PORTS** 2x USB3 • **REAR USB PORTS** 2x USB2, 4x USB3, 2x USB3.1 • **TOTAL STORAGE** 250GB SSD, 2TB hard disk • **GRAPHICS CARD** 8GB Gigabyte GeForce RTX 2070 Windforce 8G • **OPERATING SYSTEM** Windows 10 Home • **WARRANTY** Five years labour, including two years collect and return • **DETAILS** [www.chillblast.com](http://www.chillblast.com) • **PART CODE** Fusion Ryzen 7 RTX 2070 Custom Gaming PC • **FULL REVIEW** Jul 2019

NEW ENTRY



### PALICOMP AMD Abyss

★★★★★

£700 • [www.palicomp.co.uk](http://www.palicomp.co.uk)

**COMPUTER SHOPPER**  
BEST BUY

At this price, you'd seriously struggle to find a more comprehensively capable desktop system than Palicomp's AMD Abyss. It can multitask with serious applications just as well as it can run games, and with its large, fast NVMe SSD, it won't be slowed down by storage. There's a lot of room for future upgrades, too.

**PROCESSOR** Hexa-core 3.6GHz AMD Ryzen 5 2600X • **RAM** 8GB • **FRONT USB PORTS** 2x USB2, 1x USB3 • **REAR USB PORTS** 2x USB2, 2x USB3, 2x USB3.1, 1x USB Type-C • **TOTAL STORAGE** 512GB SSD, 1TB hard disk • **GRAPHICS CARD** 8GB AMD Radeon RX570 Armor 8GB OC • **OPERATING SYSTEM** Windows 10 Home • **WARRANTY** Three years RTB • **DETAILS** [www.palicomp.co.uk](http://www.palicomp.co.uk) • **PART CODE** RYZ6 • **FULL REVIEW** Apr 2019





# Choosing a... Laptop

**01** A basic laptop costing around £300 will run everyday office, multimedia and education software, but it won't be suitable for 3D gaming or processor-intensive tasks such as video editing. Many laptops at this price have a 15.6in screen and weigh over 2kg, so they're best used around the house and for occasional journeys.

**02** If you want to play modern games, you'll need a laptop with a dedicated graphics chip such as the Nvidia GeForce GTX 1060M. Good gaming laptops tend to have large 15.6 or 17in screens and weigh around 3kg, so they're best suited to use at home.

**03** If you want a laptop that you can take everywhere, look for a model that weighs less than 2kg. For the best

portability, buy one that has a 13.3in or 14in screen. In general, the smaller and lighter the laptop, the more expensive it is, especially if it has plenty of processing power.

**04** Battery life is extremely important for a laptop, particularly if you'll be carrying it around. We'd expect all but the biggest and heaviest to last for at least five hours on a single charge, but for an ultraportable that you carry everywhere, eight hours and above is more desirable.

**05** Laptops use mobile versions of processors to conserve power, and these lag behind desktop chips when it comes to performance. For a budget Windows laptop, an Intel Core i3 processor will do the job, but if you

want better performance, you should look for an Intel Core i5 or Core i7 model instead. We recommend a minimum of 4GB of RAM, although 8GB is better for multitasking.

**06** Most budget and mid-range laptops use a mechanical hard disk for storage. You'll want at least 500GB, but 1TB or more is better. Solid-state drives (SSDs) have faster performance, making your computer quicker to boot and more responsive. They have lower capacities, though. You'll need at least 128GB.

**07** Convertibles and 2-in-1 laptops can change from laptop mode to tablet mode. We've listed our favourite models later on in this guide in the Tablets section.

## LAPTOPS

### APPLE MacBook Pro 13in (2018)



£3,599 • [www.apple.com/uk](http://www.apple.com/uk)



Just like its bigger 15in brother, the latest MacBook Pro is as expensive as it is powerful, but powerful it most certainly is. This is an incredibly potent laptop, with an excellent display and blazingly fast storage, all within a thin and attractive chassis.



**PROCESSOR** Quad-core 2.7GHz Intel Core i7-8559U • **RAM** 16GB • **DIMENSIONS** 304x212x14.9mm • **WEIGHT** 1.37kg • **SCREEN SIZE** 13.3in • **SCREEN RESOLUTION** 2,560x1,440 • **GRAPHICS ADAPTOR** Intel Iris Plus 655 • **TOTAL STORAGE** 2TB SSD • **OPERATING SYSTEM** macOS • **WARRANTY** One year RTB • **DETAILS** [www.apple.com/uk](http://www.apple.com/uk) • **PART CODE** MacBook Pro 13in • **FULL REVIEW** Dec 2018

### ACER Aspire 5



£650 • [www.amzn.to/2MS5lqc](http://www.amzn.to/2MS5lqc)



The Aspire 5 is the epitome of the sensible mid-range laptop. It's not ultra-stylish and it doesn't have a professional-quality display, but for the price it offers reliable performance in a variety of workloads, and it will last a full day on battery power without much trouble.



**PROCESSOR** Quad-core 1.6GHz Intel Core i5-8250U • **RAM** 8GB • **DIMENSIONS** 382x263x21mm • **WEIGHT** 2.2kg • **SCREEN SIZE** 15.6in • **SCREEN RESOLUTION** 1,920x1,080 • **TOTAL STORAGE** 256GB SSD • **OPERATING SYSTEM** Windows 10 Home • **WARRANTY** One year RTB • **DETAILS** [www.acer.com](http://www.acer.com) • **PART CODE** A515-51-50YS • **FULL REVIEW** Oct 2018

### HUAWEI MateBook 14



£1,500 • [consumer.huawei.com](http://consumer.huawei.com)



The MateBook 14 is the biggest and best of Huawei's 2019 ultraportables. Like the more expensive MateBook X Pro, it can be equipped with a Core i7 processor, but an airier chassis means that performance isn't compromised to prevent heat build-up. Other highlights include long battery life and Nvidia's updated MX250 GPU.



**PROCESSOR** Quad-core 1.8GHz Intel Core i7-8565U • **RAM** 16GB • **DIMENSIONS** 308x224x15.9mm • **WEIGHT** 1.5kg • **SCREEN SIZE** 14in • **SCREEN RESOLUTION** 2,160x1,440 • **GRAPHICS ADAPTOR** Nvidia GeForce MX250 • **TOTAL STORAGE** 512GB SSD • **OPERATING SYSTEM** Windows 10 Home • **PARTS AND LABOUR WARRANTY** Two years RTB • **DETAILS** [consumer.huawei.com](http://consumer.huawei.com) • **PART CODE** KLV-W29 • **FULL REVIEW** Jun 2019

### DELL XPS 15 2-in-1



£1,699 • [www.currys.co.uk](http://www.currys.co.uk)



This is everything that's great about the XPS series – the massive power, the lengthy battery life, the sleek design – given even more flexibility with a fully rotatable hinge and touchscreen. That's not the only improvement, either: this is the first XPS laptop with Dell's 'maglev' keyboard design, which gives the keys a lovely pseudo-mechanical feel.



**PROCESSOR** Quad-core 2.8GHz Intel Core i5-8305G • **RAM** 8GB • **DIMENSIONS** 354x235x16mm • **WEIGHT** 2kg • **SCREEN SIZE** 15.6in • **SCREEN RESOLUTION** 1,920x1,080 • **GRAPHICS ADAPTOR** Radeon RX Vega M GL Graphics • **TOTAL STORAGE** 256GB SSD • **OPERATING SYSTEM** Windows 10 Home • **PARTS AND LABOUR WARRANTY** One year onsite • **DETAILS** [www.dell.com/uk](http://www.dell.com/uk) • **PART CODE** XPS 15 9575 • **FULL REVIEW** Oct 2018



# Choosing a... NAS device

**01** A network-attached storage (NAS) device lets you store documents, media, and other files on its hard disks so you can share them with other devices on your network. Some have disks already installed, while others are empty enclosures into which you install your own disks. Buying an empty NAS can often be the more cost-effective option, as they're usually less expensive and give you the freedom to add disks at a later date.

You should buy one with a Gigabit Ethernet interface, as these provide the highest transfer speeds. To use a NAS device at these speeds, you'll need computers with Gigabit Ethernet network adaptors and a Gigabit Ethernet switch or router. Computers with Fast Ethernet adaptors

can still access the NAS device, but only at the much slower speed of 100Mbit/s.

**02** The amount of network storage you need depends on the types of files you use. If you want to store Word and Excel documents, for example, a 1TB device will be fine. In fact, a 1TB device should be sufficient for a family's entire media collection, regardless of how many music and video files everyone owns. Small businesses should consider higher storage capacities, depending on the nature of the business.

**03** If you can see no end to your storage needs, you should buy an upgradable NAS device. Many have a USB port for adding an external disk. Devices such as

Synology's barebones NAS kits have spare disk trays for cheaper and faster upgrades.

**04** If you want extra protection for your data, look for a device that supports RAID. RAID 1 and RAID 5 arrays reduce the available capacity by duplicating data, but you won't lose it if a disk fails.

**05** If you need access to your files while you're away, look for a NAS device with an FTP server. Some can also share a USB printer across your network.

A NAS device with a Universal Plug and Play (UPnP) or DLNA media server can stream your music, photos and videos to a network media player, so you can enjoy your media collection in another room.

## STORAGE

### SYNOLOGY DiskStation DS418j

★★★★★

£281 • [www.broadbandbuyer.com](http://www.broadbandbuyer.com)

**COMPUTER SHOPPER**  
BEST BUY

When a tiny two-bay NAS won't cut it, the fast, high-capacity DiskStation DS418j

is an excellent upgrade, especially as it can automatically convert old hard disks to be compatible with this NAS's hardware and features.

3.5in HARD DISK BAYS (FREE) 4 (4) • NETWORKING 1x 10/100/1,000 Ethernet • DLNA MEDIA SERVER Yes • PRINT SERVER Yes • DIMENSIONS 184x168x230mm • WEIGHT 2.21kg • WARRANTY Two years RTB • DETAILS [www.synology.com](http://www.synology.com) • PART CODE DS418j • FULL REVIEW Jan 2018



### INTEL Optane Memory 32GB

★★★★★

£55 • [www.currys.co.uk](http://www.currys.co.uk)

**COMPUTER SHOPPER**  
RECOMMENDED

An interesting twist on M.2 SSDs, Optane Memory isn't so much a dedicated storage drive as a large cache for your existing hard disk, accelerating its read speeds to NVMe levels at a much lower price.



CAPACITY 32GB • PRICE PER GIGABYTE £1.72 • INTERFACE M.2/NVMe • WARRANTY Five years RTB • DETAILS [www.intel.com](http://www.intel.com) • PART CODE MEMPEK1W032GAXT • FULL REVIEW Sep 2017

### ADATA XPG SX8200 Pro 1TB

★★★★★

£150 • [www.cclonline.com](http://www.cclonline.com)

**COMPUTER SHOPPER**  
BEST BUY

The Adata XPG SX8200 Pro is outrageously

good value for the performance it delivers. It's as fast as or faster than top-tier SSDs from Samsung and WD, but costs far less across all its capacity options.

CAPACITY 1TB • COST PER GIGABYTE £0.15p • INTERFACE M.2/NVMe • WARRANTY Five years RTB • DETAILS [www.xpg.com](http://www.xpg.com) • PART CODE ASX8200PNP-1TT • FULL REVIEW Apr 2019



### WD Red 6TB

★★★★★

£164 • [www.amzn.to/2nEZIAQ](http://www.amzn.to/2nEZIAQ)

**COMPUTER SHOPPER**  
RECOMMENDED

This is pricier than most 6TB hard disks, even those created specifically for NAS drives, but the WD Red's performance makes it a worthwhile investment. Despite its 5,400rpm spin speed it manages to outperform 7,200rpm drives such as the Toshiba N300 in read/write tests.



CAPACITY 6TB • COST PER GIGABYTE £0.03p • INTERFACE SATA3 • CLAIMED READ 175MB/s • CLAIMED WRITE 175MB/s • WARRANTY Three years RTB • DETAILS [www.wdc.com](http://www.wdc.com) • PART CODE WD60EFRX • FULL REVIEW Nov 2017

### SAMSUNG Portable SSD X5 1TB

★★★★★

£418 • [www.amzn.to/2DNc17x](http://www.amzn.to/2DNc17x)

**COMPUTER SHOPPER**  
BEST BUY

For when you absolutely need to shift files as quickly as possible, there's the X5. Its use of the Thunderbolt 3 interface makes it the fastest external SSD ever.



CAPACITY 1TB • COST PER GIGABYTE £0.42p • INTERFACE Thunderbolt 3 • WARRANTY Three years RTB • DETAILS [www.samsung.com/uk](http://www.samsung.com/uk) • PART CODE MU-PB1T0B/WW • FULL REVIEW Dec 2018

### SAMSUNG 970 Evo Plus 500GB

★★★★★

£106 • [www.amzn.to/2CrstZB](http://www.amzn.to/2CrstZB)

**COMPUTER SHOPPER**  
RECOMMENDED

A significant write speed upgrade helps make the 970 Evo Plus a superlatively speedy M.2 SSD, and at prices much lower than the original 970 Evo's equivalent capacities.



CAPACITY 500GB • COST PER GIGABYTE £0.21p • INTERFACE M.2/NVMe • CLAIMED READ 3,500MB/s • CLAIMED WRITE 3,300MB/s • WARRANTY Five years RTB • DETAILS [www.samsung.com/uk](http://www.samsung.com/uk) • PART CODE MZ-V7S500BW • FULL REVIEW May 2019



# Choosing an... AMD motherboard

**01** As with Intel motherboards, you'll need to make sure you match an AMD processor with a compatible motherboard. This is relatively simple for AMD hardware, as most of its recent chips use the same AM4 socket, and the most recent second-generation Ryzen processors are backwards-compatible with first-generation chipsets, such as the X370 and B350.

**02** Budget APU and a minority of Ryzen processors have integrated graphics, so to make use of this, ensure that your motherboard comes with video outputs such as DVI, HDMI and DisplayPort. For Ryzen chips that lack integrated graphics, or if you want more graphics power, install a dedicated graphics card into one of your

motherboard's PCI-E x16 slots. This also has the benefit of providing a greater range of video outputs to choose from.

**03** Normal tower cases can accommodate ATX motherboards, which provide the most expansion slots. A microATX motherboard will let you build your PC in a smaller case, but if you opt for a microATX board, make sure it has all the features you need built in, as there won't be much room for expansion cards.

**04** If you want to install lots of expansion cards, look for a motherboard that offers plenty of PCI and PCI-E x1 slots. Some motherboards also have PCI-E x4 slots and extra PCI-E x16

slots. PCI-E x1 and x4 cards also work in PCI-E x16 slots. If you need a lot of storage, a motherboard with plenty of SATA2 and SATA3 ports is essential. SATA2 is fine for optical drives and hard disks, but to make the most of an SSD, you need SATA3.

**05** All motherboards have built-in audio chipsets, but some support only 5.1 surround sound rather than 7.1. If you're connecting to older surround-sound amplifiers that don't have HDMI, look for an optical or coaxial S/PDIF output.

All motherboards have Ethernet ports and most have the faster Gigabit version. You may also find it useful to buy a board with built-in Wi-Fi so you don't have to use up a USB port or PCI slot with an adaptor.

## COMPONENTS

### INTEL Core i9-9900K

★★★★★

£470 • [www.amzn.to/2KYuQtF](http://www.amzn.to/2KYuQtF)

**COMPUTER SHOPPER**  
RECOMMENDED

Intel's 9th-gen chips see it finally joining the octa-core club, including the flagship Core i9-9900K. With Turbo Boost speeds hitting 5GHz straight out of the box, it's just as potent in single-core gaming as it is in serious multithreaded workloads.

**SOCKET** LGA1151 • **CORES** 8 • **FREQUENCY** 3.6GHz • **INTEGRATED GRAPHICS** Intel UHD Graphics 630 • **WARRANTY** Three years RTB • **DETAILS** [www.intel.com](http://www.intel.com) • **PART CODE** BX80684I99900K • **FULL REVIEW** Jan 2019



### MSI GeForce RTX 2070 Armor 8G

★★★★★

£450 • [www.ebuyer.com](http://www.ebuyer.com)

**COMPUTER SHOPPER**  
BEST BUY

Whereas the RTX 2080 and RTX 2080 Ti charge exorbitant amounts for their fancy ray-tracing and anti-aliasing tech, the RTX 2070 delivers the same features at a much more reasonable price. It can also handle 4K gaming without much fuss, and MSI's version stays very cool under load.

**GPU** Nvidia GeForce RTX 2070 • **MEMORY** 8GB GDDR6 • **GRAPHICS CARD LENGTH** 155mm • **WARRANTY** One year RTB • **DETAILS** [www.msi.com](http://www.msi.com) • **PART CODE** RTX 2070 Armor 8G • **FULL REVIEW** Mar 2019



### AMD Ryzen 7 2700X

★★★★★

£270 • [www.amzn.to/2JvaEyCk](http://www.amzn.to/2JvaEyCk)

**COMPUTER SHOPPER**  
BEST BUY

AMD's second generation of Ryzen processors gets off to an auspicious start with the mighty Ryzen 7 2700X. It's faster than Intel's equivalent Core i7-8700K at stock speeds, despite being cheaper, and temperatures stay low even when overclocking.

**SOCKET** AM4 • **CORES** 8 • **FREQUENCY** 3.7GHz • **INTEGRATED GRAPHICS** None • **WARRANTY** Two years RTB • **DETAILS** [www.amd.com](http://www.amd.com) • **PART CODE** YD270XBGAFOX • **FULL REVIEW** Aug 2018



### THERMALTAKE View 37

★★★★★

£108 • [www.scan.co.uk](http://www.scan.co.uk)

**COMPUTER SHOPPER**  
BEST BUY

A spacious, feature-rich chassis for both ATX- and EATX-based builds, the View 37 comes with a gull-wing side window that's perfect for showing off your handiwork.

**CASE TYPE** Mid-tower • **MOTHERBOARD TYPE** ATX, EATX, microATX, Mini-ITX • **SUPPLIED FANS** 2x 140mm • **MAX DRIVE BAYS** 7x 3.5in, 11x 2.5in • **DIMENSIONS** 525x261x538mm • **WEIGHT** 11.8kg • **WARRANTY** Three years RTB • **DETAILS** [www.thermaltake.com](http://www.thermaltake.com) • **PART CODE** CA-1J7-00M1WN-00 • **FULL REVIEW** Dec 2018



### HYPERX Alloy Elite

★★★★★

£96 • [www.currys.co.uk](http://www.currys.co.uk)

**COMPUTER SHOPPER**  
BEST BUY

This is a brilliant do-it-all gaming keyboard; the agile Cherry MX Red key switches provide a strong foundation, upon which HyperX has built a comfortable, detachable wrist rest, dedicated media keys and customisable red backlighting. The USB pass-through port is handy, too.

**KEYBOARD SHAPE** Full size • **NUMBER PAD** Yes • **CONNECTION** 2x USB2 • **MEDIA KEYS** Pause/play, mute, skip, volume • **USB PORTS** 1x USB2 • **WARRANTY** Two years repair and replace • **DETAILS** [www.hyperxgaming.com](http://www.hyperxgaming.com) • **PART CODE** HX-KB2RD1-UK/R1 • **FULL REVIEW** Mar 2018



### MSI MPG Z390 Gaming Edge AC

★★★★★

£140 • [www.scan.co.uk](http://www.scan.co.uk)

**COMPUTER SHOPPER**  
BEST BUY

From built-in 802.11ac Wi-Fi and Bluetooth to high-end audio connectivity, the MPG Z370 Gaming Edge AC is stuffed with features. Add in a good price, easy overclocking and a well-designed BIOS, and it's perfect for premium Intel-based builds.

**PROCESSOR SOCKET** LGA1151 • **DIMENSIONS** 305x244mm • **CHIPSET** Intel Z390 • **MEMORY SLOTS** 4 • **PCI-E x16 SLOTS** 3 • **PCI-E x1 SLOTS** 3 • **PCI SLOTS** 0 • **USB PORTS** 2x USB2, 2x USB3, 1x USB3.1, 1x USB Type-C • **VIDEO OUTPUTS** 1x HDMI, 1x DisplayPort • **WARRANTY** One year RTB • **DETAILS** [www.msi.com](http://www.msi.com) • **PART CODE** MPG Z390 Gaming Edge AC • **FULL REVIEW** Apr 2019





# Choosing a... Custom PC spec

**01** Building your own PC is often cheaper than buying a pre-made system, and gives full control over the components. You don't need any special computer knowledge: just a few spare hours, a screwdriver and your choice of parts. Even things such as liquid-cooling systems can be found in user-friendly, easy-to-install packages, and for the most part it's as simple as inserting each component into a particular slot.

**02** Arguably the most important component is the CPU. These days you can get a quad-core chip even on a tight budget, which should provide more than enough brainpower for simple tasks such as web browsing, but hexa-core and octa-core chips are better for tougher jobs such as media editing, gaming and content creation.

The CPU will also determine which motherboards you can choose from. Intel CPUs will only work with boards that use an Intel chipset, like Z390, Z370 and B360, while AMD processors need AMD chipsets, such as X470 and B450.

**03** When choosing a motherboard, think about both the size of the PC's chassis (smaller cases won't fit larger ATX or EATX boards, for instance) and how many

additional components you'll want to install. For systems with a lot of expansion cards (such as graphics cards, sound cards or Wi-Fi cards), it's best to go with ATX motherboards and larger. For simpler builds, microATX or Mini-ITX boards could well provide all the connectivity you need. Keep in mind, too, that if you want to try overclocking, only certain Intel chipsets will support it, such as Z370 and Z390. AMD is more relaxed, enabling overclocking on all its Ryzen-compatible chipsets, except A320 and A300.

**04** While CPU integrated graphics will suffice for everyday browsing, a dedicated graphics card is essential for high-quality gaming. These can be installed in a PCI-E x16 slot on your motherboard, and have the bonus of adding more display outputs to use – just make sure the card will fit inside your chosen case.

**05** On the subject of cases, personal taste will factor highly here: nobody wants an ugly PC. That said, picking a chassis with adequate space for components is vital. As already mentioned, an ATX motherboard likely won't fit in a mini-tower case, and if you want to install a lot of hard disks, you'll need a case with sufficient drive bays.

**06** Every PC requires RAM and a PSU. Performance doesn't vary much between specific models, but generally you should aim for 8GB of RAM for a basic build and 16GB for higher-end systems, and at least a 550W, Bronze-certified PSU. It's better to buy a higher-wattage PSU than you strictly need, as it will allow you to add more components in the future. Also, check which RAM is compatible with your motherboard before buying, although for all current models it's probably going to be DDR4.

**07** Our recommended storage setup comprises both an SSD and a larger mechanical hard disk. By installing Windows (and a few choice applications) on the SSD, you can ensure fast booting and loading times, while the HDD is a cost-effective way of storing lots of files. Alternatively, you could buy a hard disk, and then install an Intel Optane Memory module to accelerate its write speeds to SSD levels, although since SSDs are barely more expensive than Optane drives, this is perhaps better for situations when you want to upgrade from an existing hard disk, rather than when you're building a whole new system. In the latter case, an SSD/HDD combo is better all round. See page 58 for our recommended storage drives.

## BUDGET PCs

### AMD Ryzen 3 2200G

★★★★★

£83 • [www.amzn.to/2TmlHh](http://www.amzn.to/2TmlHh)



This plucky quad-core chip is decently fast, comes bundled with its own cooler and – unlike most Ryzen chips – includes integrated Radeon RX Vega graphics. It's therefore particularly ideal if you don't need the added power of dedicated graphics.



**SOCKET** AM4 • **CORES** 4 • **FREQUENCY** 3.4GHz • **INTEGRATED GRAPHICS** AMD Radeon RX Vega 8 • **WARRANTY** Three years RTB • **DETAILS** [www.amd.com](http://www.amd.com) • **PART CODE** YD2200C5FBB0X • **FULL REVIEW** Jul 2018

### ASROCK Fatal1ty AB350 Gaming-ITX/ac

★★★★★

£90 • [www.cclonline.com](http://www.cclonline.com)



Tiny it may be, but the AB350 makes the most of what space it has available. Multiple display outputs, a rear-mounted M.2 port and onboard Wi-Fi mean it almost has the specs of a respectable ATX model.



**PROCESSOR SOCKET** AM4 • **DIMENSIONS** 170x170mm • **CHIPSET** AMD B350 • **MEMORY SLOTS** 2 • **PCI-E X16 SLOTS** 1 • **PCI-E X1 SLOTS** 0 • **PCI SLOTS** 0 • **USB PORTS** 2x USB2, 2x USB3, 1x USB Type-C • **VIDEO OUTPUTS** 2x HDMI • **WARRANTY** One year RTB • **DETAILS** [www.asrock.com](http://www.asrock.com) • **PART CODE** 90-MXB5P0-A0UAYZ • **FULL REVIEW** Jul 2018

### THERMALTAKE Versa H18

★★★★★

£40 • [www.kustompcs.co.uk](http://www.kustompcs.co.uk)



Budget PC cases are often lacking in both features and capacity for upgrades. The Versa H18 isn't entirely exempt, and is limited to smaller motherboards, but it can easily cope with basic components and ambitious water-cooled builds alike.



**CASE TYPE** Mini-tower • **MOTHERBOARD TYPE** MicroATX, Mini-ITX • **SUPPLIED FANS** 1x 120mm • **MAX DRIVE BAYS** 2x 3.5in, 2x 2.5in • **DIMENSIONS** 390x205x380mm • **WEIGHT** 4.5kg • **WARRANTY** Three years RTB • **DETAILS** [www.thermaltake.com](http://www.thermaltake.com) • **PART CODE** CA-1J4-00S1WN-00 • **FULL REVIEW** Nov 2018

### ZOTAC GeForce GTX 1050 Ti Mini

★★★★★

£140 • [www.amzn.to/2Qi7bG7](http://www.amzn.to/2Qi7bG7)



An optional purchase, thanks to the Ryzen CPU's onboard graphics, but if you'd like a spot of 1080p gaming capability, the GTX 1050 Ti is the best budget GPU around. Zotac's compact design will allow it to easily fit in small cases, too.



**GPU** Nvidia GeForce GTX 1050 Ti • **MEMORY** 4GB GDDR5 • **GRAPHICS CARD LENGTH** 145mm • **WARRANTY** Five years RTB • **DETAILS** [www.zotac.com](http://www.zotac.com) • **PART CODE** ZT-P10510A-10L • **FULL REVIEW** Nov 2017



## MID-RANGE PCs

### AMD Ryzen 7 1700

★★★★★

£150 • [www.amzn.to/2RhQGHP](http://www.amzn.to/2RhQGHP)



Both AMD and Intel have recent mid-range chips, but with the erstwhile high-end Ryzen 7 1700 dropping below £200, it's a great way of adding octa-core power to a PC that might otherwise have had to make do with six cores.



**SOCKET** AM4 • **CORES** 8 • **FREQUENCY** 3.0GHz • **INTEGRATED GRAPHICS** None • **WARRANTY** Three years RTB • **DETAILS** [www.amd.com](http://www.amd.com) • **PART CODE** YD1700BBAEBOX • **FULL REVIEW** Jul 2017

### MSI B350M Mortar

★★★★★

£100 • [www.amzn.to/2zuBbF1](http://www.amzn.to/2zuBbF1)



A near-perfect motherboard for AMD Ryzen-based microATX systems. It's remarkably well equipped for connectivity and upgradability, and comes close to much more expensive mobos in performance benchmarks.



**PROCESSOR SOCKET** AM4 • **DIMENSIONS** 244x244mm • **CHIPSET** AMD B350 • **MEMORY SLOTS** 4 • **PCI-E X16 SLOTS** 2 • **PCI-E X1 SLOTS** 2 • **PCI SLOTS** 0 • **USB PORTS** 2x USB2, 3x USB3.1, 1x USB Type-C • **VIDEO OUTPUTS** 1x HDMI, 1x DisplayPort, 1x DVI-D • **WARRANTY** One year RTB • **DETAILS** [www.msi.com](http://www.msi.com) • **PART CODE** B350M Mortar • **FULL REVIEW** Jul 2018

### NVIDIA GeForce RTX 2060 Founders Edition

★★★★★

£329 • [www.nvidia.com](http://www.nvidia.com)



This is expensive for a mid-range GPU, but it's also very powerful for a mid-range model. Besides borderline 4K-ready core performance, this comes with the same ray-tracing and DLSS bells and whistles as Nvidia's premium RTX cards, so it's still pretty good value in the end.



**GPU** Nvidia GeForce RTX 2060 • **MEMORY** 6GB GDDR6 • **GRAPHICS CARD LENGTH** 229mm • **WARRANTY** Three years repair and replace • **DETAILS** [www.nvidia.com](http://www.nvidia.com) • **PART CODE** GeForce RTX 2060 Founders Edition • **FULL REVIEW** May 2019

### COOLER MASTER MasterBox K500

★★★★★

£75 • [www.scan.co.uk](http://www.scan.co.uk)



Great looks, a full set of pre-installed fans, high build quality and a spacious interior: the MasterBox K500 is a commendable all-rounder. It's not the best on storage capacity, but you can still add at least a couple of SSDs and hard disks each.



**CASE TYPE** Mid-tower • **MOTHERBOARD TYPE** ATX, microATX, Mini-ITX • **SUPPLIED FANS** 3x 120mm • **MAX DRIVE BAYS** 3x 3.5in, 2x 2.5in • **DIMENSIONS** 260x190x280mm • **WEIGHT** 6.2kg • **WARRANTY** Two years RTB • **DETAILS** [www.cooler-master.com](http://www.cooler-master.com) • **PART CODE** MCB-K500D-KGNN-S00 • **FULL REVIEW** Jan 2019

## PREMIUM PCs

### INTEL Core i9-9900K

★★★★★

£470 • [www.ebuyer.com](http://www.ebuyer.com)



Intel's 9th-gen chips see it finally joining the octa-core club, including the flagship Core i9-9900K. With Turbo Boost speeds hitting 5GHz straight out of the box, it's as potent in single-core gaming as it is in serious multithreaded workloads.



**SOCKET** LGA1151 • **CORES** 8 • **FREQUENCY** 3.6GHz • **INTEGRATED GRAPHICS** Intel UHD Graphics 630 • **WARRANTY** Three years RTB • **DETAILS** [www.intel.com](http://www.intel.com) • **PART CODE** BX80684I99900K • **FULL REVIEW** Jan 2019

### MSI MPG Z390 Gaming Edge AC

★★★★★

£140 • [www.scan.co.uk](http://www.scan.co.uk)



From built-in 802.11ac Wi-Fi and Bluetooth to high-end audio connectivity, the MPG Z370 Gaming Edge AC is stuffed with features. Add in a good price, easy overclocking and a well-designed BIOS, and it's perfect for premium Intel-based builds.



**PROCESSOR SOCKET** LGA1151 • **DIMENSIONS** 305x244mm • **CHIPSET** Intel Z390 • **MEMORY SLOTS** 4 • **PCI-E X16 SLOTS** 3 • **PCI-E X1 SLOTS** 3 • **PCI SLOTS** 0 • **USB PORTS** 2x USB2, 2x USB3, 1x USB3.1, 1x USB Type-C • **VIDEO OUTPUTS** 1x HDMI, 1x DisplayPort • **WARRANTY** One year RTB • **DETAILS** [www.msi.com](http://www.msi.com) • **PART CODE** MPG Z390 Gaming Edge AC • **FULL REVIEW** Apr 2019

### THERMALTAKE View 37

★★★★★

£108 • [www.scan.co.uk](http://www.scan.co.uk)



A spacious, feature-rich chassis for both ATX- and EATX-based builds, the View 37 comes with a gull-wing side window that's perfect for showing off your handiwork.



**CASE TYPE** Mid-tower • **MOTHERBOARD TYPE** ATX, EATX, microATX, Mini-ITX • **SUPPLIED FANS** 2x 140mm • **MAXIMUM DRIVE BAYS** 7x 3.5in, 11x 2.5in • **DIMENSIONS** 525x261x538mm • **WEIGHT** 11.8kg • **WARRANTY** Three years RTB • **DETAILS** [www.thermaltake.com](http://www.thermaltake.com) • **PART CODE** CA-1J7-00M1WN-00 • **FULL REVIEW** Dec 2018

### MSI GeForce RTX 2070 Armor 8G

★★★★★

£450 • [www.ebuyer.com](http://www.ebuyer.com)



Whereas the RTX 2080 and RTX 2080 Ti charge exorbitant amounts for their fancy ray-tracing and anti-aliasing tech, the RTX 2070 delivers the same features at a much more reasonable price. It can also handle 4K gaming without much fuss, and MSI's version stays very cool under load.



**GPU** Nvidia GeForce RTX 2070 • **MEMORY** 8GB GDDR6 • **GRAPHICS CARD LENGTH** 155mm • **WARRANTY** One year RTB • **DETAILS** [www.msi.com](http://www.msi.com) • **PART CODE** RTX 2070 Armor 8G • **FULL REVIEW** Mar 2019



# Choosing a... Display

**01** A basic 24in LCD monitor costs around £100. It will be fine for typical Windows work but is likely to have poor viewing angles, so you'll need to sit straight on for the best picture quality. Its colour accuracy may not be very good, either.

**02** A VGA input lets you use the monitor with any PC, but the quality may not be as good as it is over DVI or HDMI. Both are digital connections and require a compatible graphics card but they avoid the need for digital-to-analogue or analogue-to-digital conversions, which can reduce image quality. A digital connection achieves the best picture automatically, so you won't have to adjust clock or phase settings as you do with analogue connections.

Many DVI and all HDMI connections support HDCP, which lets you watch protected video content, such as Blu-ray movies. DisplayPort is becoming more popular, but you'll need a graphics card with a DisplayPort output (mini or full-size) to use this input on your monitor.

**03** A larger monitor will be easier on the eye and may have a higher resolution. Most monitors have a resolution of at least 1,920x1,080 (1080p), which provides lots of room for working with multiple windows at the same time. For even higher resolutions, you'll need a larger display. Some 27in and 30in screens have 2,560x1,600 or even 4K resolutions. You'll need a graphics card with a dual-link DVI output and a dual-link DVI

cable or either HDMI or DisplayPort to use a monitor at these resolutions.

**04** If you want better picture quality, look for a monitor with a high contrast ratio. The higher the ratio, the whiter the whites and the blacker the blacks. You'll also be able to see more fine detail in images with high contrast levels. Viewing angles are important, as wider angles mean you don't have to sit directly in front of the monitor to get the best picture. Wider viewing angles also allow more people to view the screen at the same time.

Fast response times reduce ghosting, but don't be dazzled by the numbers. A response time of 25ms or quicker is fine for all applications.

## DISPLAYS

### LG 34GK950F

★★★★★

£1,150 • [www.overclockers.co.uk](http://www.overclockers.co.uk)



LG's curved ultrawide monitor is as versatile as it

is vibrant. HDR is supported (if only to the DisplayHDR 400 standard), colours are accurate, and both AMD FreeSync and Nvidia G-Sync can smooth out games.



SCREEN SIZE 34in • RESOLUTION 3,440x1,440 • REFRESH RATE 144Hz • SCREEN TECHNOLOGY IPS • VIDEO INPUTS HDMI, DisplayPort • WARRANTY Three years collect and return • DETAILS [www.lg.com](http://www.lg.com) • FULL REVIEW Jun 2019

### Iiyama G-Master Black Hawk G2530HSU-B1

★★★★★

£123 • [www.box.co.uk](http://www.box.co.uk)



A fine alternative monitor to the AOC G2460VQ6, also with a 75Hz refresh rate as well as FreeSync support for tear-free gaming on AMD graphics cards. The slim-bezel design is good for the money, too.



SCREEN SIZE 24in • RESOLUTION 1,920x1,080 • SCREEN TECHNOLOGY TN • VIDEO INPUTS HDMI, DisplayPort, VGA • WARRANTY Two years onsite • DETAILS [www.iiyama.com](http://www.iiyama.com) • PART CODE G2530HSU-B1 • FULL REVIEW Mar 2019

### EIZO ColorEdge CG279X

★★★★★

£1,699 • [www.wexphotovideo.com](http://www.wexphotovideo.com)



This professional-quality monitor benefits from automatic calibration,

ensuring practically perfect colour accuracy and wide coverage of the sRGB, DCI-P and Adobe RGB gamuts. It's a worthwhile investment for editing photos and videos.



SCREEN SIZE 27in • RESOLUTION 2,560x1,440 • SCREEN TECHNOLOGY IPS • REFRESH RATE 60Hz • VIDEO INPUTS VGA, HDMI, DisplayPort, DVI, USB Type-C • WARRANTY Five years RTB • DETAILS [www.eizoglobal.cpm](http://www.eizoglobal.cpm) • FULL REVIEW Jun 2019

### AOC Q3279VWF

★★★★★

£180 • [www.amzn.to/2BjxUGC](http://www.amzn.to/2BjxUGC)



We never thought you could get so much monitor for this

little cash: a vast 31.5in MVA panel, with Quad HD resolution, good colour accuracy and high contrast. That's not to mention its 75Hz refresh rate and AMD FreeSync support.



SCREEN SIZE 31.5in • RESOLUTION 2,560x1,440 • SCREEN TECHNOLOGY MVA • REFRESH RATE 75Hz • VIDEO INPUTS HDMI, DisplayPort, VGA • WARRANTY Three years collect and return • DETAILS [aoc-europe.com](http://aoc-europe.com) • FULL REVIEW Mar 2018

### PHILIPS Brilliance 241B7QPJKEB

★★★★★

£182 • [www.uk.insight.com](http://www.uk.insight.com)



IPS monitors generally look great, but it's hard to find one at a low price. Enter the

Brilliance 241B7QPJKEB: a colour-accurate IPS display for well under £200. It's well designed, too, with a collapsible webcam and a greatly adjustable stand.



SCREEN SIZE 24in • RESOLUTION 1,920x1,080 • SCREEN TECHNOLOGY IPS • REFRESH RATE 60Hz • VIDEO INPUTS HDMI, DisplayPort, VGA • WARRANTY Three years RTB • DETAILS [www.philips.co.uk](http://www.philips.co.uk) • FULL REVIEW Jun 2018

### SAMSUNG C34F791

★★★★★

£649 • [www.amzn.to/2n1Nb9V](http://www.amzn.to/2n1Nb9V)



With its Quantum Dot display, the C34F791 can achieve pristine colour coverage

and superb accuracy. Its Ultra HD resolution and 34in curved screen make it ideal for multitasking, but a 100Hz refresh rate and AMD FreeSync support ensure it's even better for 4K gaming.



SCREEN SIZE 34in • RESOLUTION 3,840x1,440 • SCREEN TECHNOLOGY VA • REFRESH RATE 100Hz • VIDEO INPUTS DisplayPort, HDMI • WARRANTY Two years RTB • DETAILS [www.samsung.com/uk](http://www.samsung.com/uk) • FULL REVIEW Oct 2017



# Choosing a... Laser printer

**01** Laser printers used to be much more expensive than inkjets and were typically restricted to offices. They are now much more affordable, however, and offer several benefits over inkjets, including lower per-page printing costs and faster print speeds.

**02** A decent laser printer will typically cost around £80, and will happily print hundreds of black-and-white pages per hour. If documents are your priority, you'll want a high minimum speed and low print costs. However, you'll probably be limited to black-and-white printing at this price.

**03** Although you can still buy single-function laser printers, multifunction

peripherals (MFPs) are now far more common. These models can scan and photocopy documents as well as print them, and some of them also have fax capabilities. Laser MFPs start from around £200.

**04** Heavy-duty office lasers designed for printing thousands of pages per month can cost thousands of pounds. They use large individual toner drums, which can cut running costs. Automatic duplex (double-sided) printing is also common here.

**05** Although laser printers are more suited to printing text than graphics, many are still able to produce high-quality photographs. Speed isn't a priority here – instead choose a printer that reproduces

subtle tones well. You can't determine this by looking at the specifications; only hands-on testing will do, so remember to check our reviews before you buy. Borderless printing (up to the edge of the paper) should also be possible.

**06** If you want to print from multiple devices, make sure you look for extended connectivity. Decent laser printers can be shared on your local network and have USB ports for direct printing, memory card slots for printing images from a digital camera, and iOS, Android or Google Cloud Print support for printing from mobile devices such as smartphones or tablets. An LCD preview screen offers greater control for this method of printing.

## PRINTERS & SCANNERS

### EPSON WorkForce WF-7710DWF

★★★★★

£161 • [www.amzn.to/2JVd3B](http://www.amzn.to/2JVd3B)



**COMPUTER SHOPPER**  
BEST BUY

The WorkForce WF-7710DWF allows you to print at the larger A3+ paper size, as well as fax and scan at A3, so it's great for home office users who require a bit more flexibility from their MFP.

**TECHNOLOGY** Piezo inkjet • **MAXIMUM PRINT RESOLUTION** 4,800x2,400dpi • **DIMENSIONS** 340x567x452mm • **WEIGHT** 18.7kg • **MAXIMUM PAPER SIZE** A3+ • **WARRANTY** One year RTB • **DETAILS** [www.epson.co.uk](http://www.epson.co.uk) • **PART CODE** C11CG36411 • **FULL REVIEW** Nov 2018

### XYZPRINTING da Vinci Minimizer

★★★★★

£177 • [www.xyzprinting.com](http://www.xyzprinting.com)



**COMPUTER SHOPPER**  
RECOMMENDED

It's not as fully featured as the da Vinci Jr 1.0w, but the Minimizer prints at identical speed and quality, and costs much, much less. In fact, it's the most affordable 3D printer we've ever used.

**TECHNOLOGY** Fused Filament Fabrication • **MAXIMUM PRINT RESOLUTION** 100 microns • **MAXIMUM BUILD SIZE** 150x150x150mm • **DIMENSIONS** 390x360x335mm • **WEIGHT** 11.5kg • **FILAMENT** 1.75mm PLA • **WARRANTY** One year RTB • **DETAILS** [eu.xyzprinting.com](http://eu.xyzprinting.com) • **PART CODE** 3FM1XXEU00D • **FULL REVIEW** Apr 2017

### HP OfficeJet Pro 7720

★★★★★

£119 • [www.currys.co.uk](http://www.currys.co.uk)



**COMPUTER SHOPPER**  
BUSINESS BUY

The OfficeJet Pro 7720 strikes a fine balance between price, performance and features, making it ideal for home offices and small businesses – especially those that could use A3 printing.

**TECHNOLOGY** Thermal inkjet • **MAXIMUM PRINT RESOLUTION** 4,800x1,200dpi • **SCANNER RESOLUTION** 1,200x1,200dpi • **DIMENSIONS (HXWxD)** 307x445x585mm • **WEIGHT** 15.5kg • **MAXIMUM PAPER SIZE** A3 (print only) • **WARRANTY** Three years RTB • **DETAILS** [www.hp.co.uk](http://www.hp.co.uk) • **PART CODE** Y0S18A • **FULL REVIEW** Dec 2017

### CANON Pixma TS3150

★★★★★

£36 • [www.ebuyer.com](http://www.ebuyer.com)



**COMPUTER SHOPPER**  
RECOMMENDED

If you only print or scan infrequently, you probably don't need a load of fancy features. The Pixma TS3150 does the job for hardly any money – it's a bit slow, but the results are of a higher quality than we'd expect from a budget MFP.

**TECHNOLOGY** Thermal inkjet • **MAXIMUM PRINT RESOLUTION** 4,800x1,200dpi • **SCANNER RESOLUTION** 600x1,200dpi • **DIMENSIONS** 126x373x315mm • **WEIGHT** 3.9kg • **MAXIMUM PAPER SIZE** A4/legal • **WARRANTY** One year RTB • **DETAILS** [www.canon.co.uk](http://www.canon.co.uk) • **PART CODE** 2226C008 • **FULL REVIEW** Jan 2018

### CANON imageFormula DR-C230

★★★★★

£320 • [www.ebuyer.com](http://www.ebuyer.com)



**COMPUTER SHOPPER**  
RECOMMENDED

This sheet-fed document scanner is perfect for getting through stacks of documents without having to manually scan each page. It's pleasantly fast and pairs with Canon's powerful CaptureOnTouch Pro software, which does a fine job of processing your scans.

**TECHNOLOGY** Dual CIS sheet-fed scanner • **SCANNER RESOLUTION** 600x600dpi • **DIMENSIONS** 231x291x530mm • **WEIGHT** 2.8kg • **MAXIMUM PAPER SIZE** A4/legal • **WARRANTY** One year RTB • **DETAILS** [www.canon.co.uk](http://www.canon.co.uk) • **PART CODE** 2646C003 • **FULL REVIEW** Feb 2018

### EPSON EcoTank ET-7750

★★★★★

£546 • [www.jessops.com](http://www.jessops.com)



**COMPUTER SHOPPER**  
RECOMMENDED

Like all EcoTank MFPs, the ET-7750 offsets its high price with low running costs, and this specific model delivers sharp, solid colours that suit photo printing well.

**TECHNOLOGY** Piezo inkjet • **MAXIMUM PRINT RESOLUTION** 5,760x1,440 • **SCANNER RESOLUTION** 1,200x2,400dpi • **DIMENSIONS** 168x526x415mm • **WEIGHT** 10.5kg • **MAXIMUM PAPER SIZE** A3 • **WARRANTY** One year RTB • **DETAILS** [www.epson.co.uk](http://www.epson.co.uk) • **PART CODE** C11CG16401CE • **FULL REVIEW** Sep 2018



# Choosing a... Wireless router

**01** Wireless routers each use a number of Wi-Fi standards, so you shouldn't have any trouble connecting your computer or phone wirelessly if you get an 802.11n or 802.11ac router. Nearly all routers support 802.11n, so even a cheap model should provide decent performance.

You can expect a transfer speed of around 40Mbit/s at a distance of 10m from any modern 802.11n router. The very latest routers use the 802.11ac standard, which provides tremendously fast transfer speeds. Some devices still don't support the 802.11ac standard, so check the specifications before you buy.

**02** If you subscribe to an ADSL broadband service, you should buy

a wireless router that has a built-in ADSL modem. This will cost more than the equivalent cable router, but it allows you to connect your router directly to your broadband connection without having to use a separate modem.

**03** Most 802.11n wireless routers use the 2.4GHz frequency band. This has good range but it can be prone to interference if it's positioned close to a lot of other 2.4GHz devices, such as other routers and baby monitors. If you have trouble getting a consistent signal or you want faster speeds for video streaming, for example, it's worth buying a dual-band router that can use both the 2.4GHz and 5GHz bands.

Alternatively, a high-gain antenna can boost signals and improve ranges and throughputs to the entire house. You can also add a high-gain antenna to a PC's network adaptor. If wired network speeds are a priority, you should look for a router with a Gigabit Ethernet connection.

**04** Many routers come with built-in USB ports that let you connect a USB drive and use the router as a network storage device. If you want to share a USB printer over your network, look for a wireless router that has a USB print server.

Finally, if you're interested in making voice calls over the internet, buy a router with built-in VoIP support (and phone sockets) because this can save you money.

## NETWORKS

### BT Complete Wi-Fi

★★★★★

£5 per month • [www.bt.com](http://www.bt.com)

**COMPUTER SHOPPER**  
RECOMMENDED

There are better-featured mesh systems available, but the Complete Wi-Fi is decently quick on both the 5GHz and 2.4GHz bands, and is well worth it for BT Plus customers in particular.

**WI-FI STANDARD** 802.11ac • **STATED SPEED** 1,733Mbit/s (5GHz), 385Mbit/s (2.4GHz) • **USB PORTS** 1 • **WALL MOUNTABLE** No • **WARRANTY** Under rental contract • **PART CODE** BT Complete Wi-Fi • **FULL REVIEW** Mar 2019



### TP-LINK Archer C5400

★★★★★

£240 • [www.currys.co.uk](http://www.currys.co.uk)

**COMPUTER SHOPPER**  
RECOMMENDED

Although this isn't the fastest £200-plus router, it's still speedy, and comes with an impressive array of features, from parental controls and filters to BT YouView support and smart home integration.

**MODEM** Gigabit Ethernet • **WI-FI STANDARD** 802.11ac • **STATED SPEED** 2x 2,167Mbit/s (5GHz), 2x 1,000Mbit/s (2.4GHz) • **USB PORTS** 1x USB2, 1x USB3 • **WALL MOUNTABLE** Yes • **WARRANTY** One year RTB • **PART CODE** C5400 • **FULL REVIEW** May 2018



### YUBICO YubiKey 5 NFC

★★★★★

£38 • [www.yubico.com](http://www.yubico.com)

**COMPUTER SHOPPER**  
RECOMMENDED

Like the YubiKey 4 before it, this USB stick conveniently stores all the cryptographic data you need to add two-factor authentication to a PC or laptop; and this time, there's NFC, allowing you to use it with mobile devices via a single tap.

**USB TYPE** Type-A • **OS SUPPORT** Windows 10, macOS, iOS 11 and later, Android • **WARRANTY** One year RTB • **DETAILS** [www.yubico.com](http://www.yubico.com) • **PART CODE** YubiKey 5 NFC • **FULL REVIEW** Apr 2019



### TP-LINK Deco M5

★★★★★

£160 (triple pack) • [www.amzn.to/2L05qMi](http://www.amzn.to/2L05qMi)

**COMPUTER SHOPPER**  
BEST BUY

Provided you're willing to tinker with a few settings, the Deco M5 is the most feature-rich mesh Wi-Fi system around, even if it's not strictly the fastest. Get the triple pack for the best coverage throughout the house.

**MODEM** Gigabit Ethernet • **WI-FI STANDARD** 802.11ac • **STATED SPEED** 867Mbit/s (5GHz), 400Mbit/s (2.4GHz) • **USB PORTS** 0 • **WALL MOUNTABLE** No • **WARRANTY** Three years RTB • **DETAILS** [www.tp-link.com](http://www.tp-link.com) • **PART CODE** 210380 • **FULL REVIEW** Dec 2017



### D-LINK DIR-895L

★★★★★

£204 • [www.ebuyer.com](http://www.ebuyer.com)

**COMPUTER SHOPPER**  
BEST BUY

If you can stomach the price, D-Link's DIR-895L will make it worth your while with staggeringly fast speeds and exceptionally long range. It also lets you connect to your home network remotely, via an L2TP VPN.

**MODEM** Gigabit Ethernet • **WI-FI STANDARD** 802.11ac • **STATED SPEED** 2x 2,166Mbit/s (5GHz), 1,000Mbit/s (2.4GHz) • **USB PORTS** 1x USB2, 1x USB3 • **WALL MOUNTABLE** Yes • **WARRANTY** Two years RTB • **PART CODE** DIR-895L • **FULL REVIEW** Dec 2017



### NETGEAR Orbi RBK50

★★★★★

£260 • [www.currys.co.uk](http://www.currys.co.uk)

**COMPUTER SHOPPER**  
BEST BUY

This is an expensive mesh Wi-Fi system, but also one of the very fastest – perfect for ensuring that a high-speed connection keeps up its performance at range.

**MODEM** Gigabit Ethernet • **WI-FI STANDARD** 802.11ac • **STATED SPEED** 3,000Mbit/s • **USB PORTS** 1 • **WALL MOUNTABLE** No • **WARRANTY** Two years RTB • **PART CODE** RBK50-100UKS • **FULL REVIEW** Dec 2017





# Choosing a... Smart thermostat

**01** A smart thermostat can save you a lot of money by intelligently controlling your heating.

Most smart heating devices are designed to be used with hot water central heating systems, with the boiler directly controlled by the system. These typically require a relay to be wired into your boiler, with a wireless thermostat giving you direct control. Smartphone apps then tie into the system to give you remote control. While it's possible to fit controls yourself, you may want to pay an experienced plumber to do the job: expect to pay around £150 for a typical installation.

If you have electric heating, there are very few choices, and the big names (Nest, Honeywell and so on) do not directly support these systems.

**02** Want smart hot water control? If you want to remotely set schedules and disable hot water while you're away, choose your smart system carefully, as many don't have this option. Hot water control usually requires a second relay to be wired into the boiler.

**03** What kind of heating system do you want? There are two main choices: a central system and one with individual radiator controls. The former replaces your existing thermostat, and lets you set one temperature for your entire house. The latter requires each radiator valve to be replaced with a smart valve so that each room and radiator can have its own individual control.

This option is more expensive to install but will provide you with greater savings.

**04** Do you use a smart personal assistant? Make sure that your smart thermostat supports the one that you use. Amazon Alexa, powered by the Echo and Echo Dot, is the best-supported system; Apple's HomeKit, powered by Siri, isn't so well supported; Google Assistant, built into Google Home, is just gaining traction and supports Nest only.

**05** If you want your smart heating system to do more, look for IFTTT support. With this handy system, you can set automatic rules, such as turning the heating off if the outside temperature rises.

## SMART HOME

### AMAZON Echo Dot 3rd Generation

★★★★★

£50 • [www.amzn.to/2VVI5Bs](http://www.amzn.to/2VVI5Bs)

**COMPUTER SHOPPER**  
BEST BUY

A souped-up speaker means the latest Echo Dot is finally a viable music

player, in addition to the best-value Echo speaker and smart home controller. Buy multiple devices and you can scatter them throughout your home, maximising Alexa coverage.



**DRIVERS** 1 • **RMS POWER OUTPUT** Not stated • **WEIGHT** 300g • **NETWORKING** Bluetooth, 802.11n Wi-Fi • **WARRANTY** One year RTB • **DETAILS** [www.amazon.co.uk](http://www.amazon.co.uk) • **PART CODE** Echo Dor 3rd Generation • **FULL REVIEW** Aug 2019

### NEST Cam IQ Outdoor

★★★★★

£329 • [nest.com/uk](http://nest.com/uk)

**COMPUTER SHOPPER**  
RECOMMENDED

While this is an expensive replacement for the old Nest Cam Outdoor, its image quality is without equal. Facial and sound recognition have also been improved, and it's now much harder for thieves to remove the camera from its mount.



**VIDEO RESOLUTION** 4K sensor, 1080p recording • **CLOUD STORAGE** Yes (subscription required) • **NETWORKING** 802.11ac • **WARRANTY** One year RTB • **PART CODE** Nest Cam IQ Outdoor • **FULL REVIEW** Jul 2018

### TADO Smart Thermostat

★★★★★

£179 • [www.amzn.to/2ZxwlfZ](http://www.amzn.to/2ZxwlfZ)

**COMPUTER SHOPPER**  
BEST BUY

A flexible and stylish-looking smart heating system, the Tado Smart Thermostat distinguishes

itself with a clever geolocation feature that turns on your heating when you enter a room and switches it off, saving money, when you leave.



**REMOTE THERMOSTAT** Yes • **HOT WATER SUPPORT** Yes • **INDIVIDUAL RADIATOR CONTROL** Yes • **VOICE ASSISTANT SUPPORT** Alexa, Google Assistant, Siri • **APPS** iOS, Android and web • **FULL REVIEW** Jan 2018

### NEOS Smartcam

★★★★★

£20 • [shop.neos.co.uk](http://shop.neos.co.uk)

**COMPUTER SHOPPER**  
RECOMMENDED

The Smartcam is a tremendous bargain of an indoor security camera. In many ways, it's not all that advanced – footage is only shot at up to 15fps, for instance – but the 1080p resolution, night-vision mode and free cloud storage make for a nifty little package.



**VIDEO RESOLUTION** 1080p • **CLOUD STORAGE** Yes (free) • **NETWORKING** 802.11n • **WARRANTY** One year RTB • **PART CODE** NS-CAM-02 • **FULL REVIEW** Jun 2019

### GOOGLE Home Hub

★★★★★

£119 • [www.currys.co.uk](http://www.currys.co.uk)

**COMPUTER SHOPPER**  
BEST BUY

The first truly excellent smart screen, Google's Home Hub is both a

multitalented smart home controller and a very clever device in itself, jumping seamlessly between providing mapped-out travel routes, playing YouTube videos and showcasing photo albums.



**DRIVERS** 1 • **RMS POWER OUTPUT** Not stated • **DOCK CONNECTOR** None • **WIRELESS** 802.11ac Wi-Fi, Bluetooth 5.0 • **DIMENSIONS** 118x179x67mm • **WEIGHT** 480g • **WARRANTY** One year RTB • **PART CODE** Home Hub • **FULL REVIEW** Feb 2019

### RING Video Doorbell 2

★★★★★

£149 • [www.box.co.uk](http://www.box.co.uk)

**COMPUTER SHOPPER**  
BEST BUY

This is the best of the new breed of smart, camera-equipped doorbells: it's easy to install, comes with a bundled chime, and has fairly low subscription costs for storing footage in the cloud.



**VIDEO RESOLUTION** 1080p • **CLOUD STORAGE** Yes • **NETWORKING** 802.11n • **WARRANTY** Two years parts and theft protection • **PART CODE** 8VR1S7-0EU0 • **FULL REVIEW** Dec 2018



# Choosing a... Smartphone

**01** A smartphone's operating system (OS) dictates its basic features and which third-party software you can install. There are three main contenders: Apple's iOS, which is found on the iPhone, Google's Android, which is used by various handset manufacturers, and Windows Phone, which has few options, especially since Microsoft has discontinued support for its OS. Apple iOS and Google Android both have thousands of apps available.

**02** All smartphones have colour screens, but their resolutions vary. Basic models have 1,280x720 pixels, but text can be indistinct. Look for a display that has at least 1,920x1,080 pixels so it's easier to read text

and watch Full HD videos. Don't worry too much about built-in media players or Office document editors; you can always install apps to replace these with better versions later.

The image quality of smartphone cameras has improved tremendously in recent years, and resolutions have increased to as high as 20 megapixels.

**03** Very few modern smartphones have a physical keyboard for entering text; they almost exclusively use touchscreens now. Physical keyboards can aid heavy emailing, but today's touchscreen keyboards work just as well.

Android smartphones and iPhones running iOS 9 or above allow you to install

a variety of custom onscreen keyboards so you can find one that suits you.

**04** Be careful when choosing a contract. Look for one that includes a large data allowance if you want to use the internet regularly or you've set your phone to synchronise your contacts, calendar and email through online services.

Built-in Wi-Fi can help you avoid high data charges by connecting to the internet through wireless hotspots when you're out, or your router when you're at home. Android and iPhone handsets can operate as wireless hotspots, letting you connect your laptop to the web over your mobile data connection. There may be an extra charge for this.

## SMARTPHONES

### MOTOROLA Moto G7 Power

★★★★★

£180 SIM-free, £15-per-month contract • [www.carphonewarehouse.com](http://www.carphonewarehouse.com)

**COMPUTER SHOPPER**  
BEST BUY

There's no shortage of Moto G7 variants to choose from, but the Moto G7 Power is easily the best value. It focuses on battery life and is thus one of the longest-lasting smartphones ever - and its performance, display and rear camera are all rather good for the price, too.



**PROCESSOR** Octa-core 1.8GHz Qualcomm Snapdragon 632 • **SCREEN SIZE** 6.2in • **SCREEN RESOLUTION** 1,520x720 • **REAR CAMERA** 12 megapixels • **STORAGE** 32GB • **WIRELESS DATA** 4G • **SIZE** 159x76x9.3mm • **WEIGHT** 193g • **OPERATING SYSTEM** Android 9.0 • **WARRANTY** One year RTB • **DETAILS** [www.motorola.co.uk](http://www.motorola.co.uk) • **PART CODE** PAE90019GB • **FULL REVIEW** June 2019

### SAMSUNG Galaxy S10+

★★★★★

£772 SIM-free; £10 up front plus £59-per-month contract • [www.amzn.to/2E8ImVE](http://www.amzn.to/2E8ImVE) (SIM-free); [www.carphonewarehouse.com](http://www.carphonewarehouse.com) (contract)

**COMPUTER SHOPPER**  
BEST BUY

The dazzling 3K display dominates a sleek, luxurious-feeling design, while the Exynos 9820 processor delivers some of the fastest raw performance on any Android handset, ever.



**PROCESSOR** Octa-core 2.7GHz Samsung Exynos 9820 • **SCREEN SIZE** 6.4in • **SCREEN RESOLUTION** 3,040x1,440 • **REAR CAMERAS** 12 megapixels, 12 megapixels, 16 megapixels • **STORAGE** 128GB • **WIRELESS DATA** 4G • **DIMENSIONS** 158x74x7.8mm • **WEIGHT** 175g • **OPERATING SYSTEM** Android 9.0 • **WARRANTY** One year RTB • **DETAILS** [www.samsung.com](http://www.samsung.com) • **PART CODE** SM-G975FZKDBTU • **FULL REVIEW** Jul 2019

### HONOR 7X

★★★★★

£180 SIM-free; £27-per-month contract • [www.amzn.to/2UUsVg](http://www.amzn.to/2UUsVg) (SIM-free); [www.three.co.uk](http://www.three.co.uk) (contract)

**COMPUTER SHOPPER**  
BEST BUY

Don't fancy paying tons of cash for an edge-to-edge, 18:9 display? The Honor 7X is affordable but has a vast, vibrant screen, and comes with a great dual-camera array.



**PROCESSOR** Octa-core 2.36GHz HiSilicon Kirin 659 • **SCREEN SIZE** 6in • **SCREEN RESOLUTION** 2,160x1,080 • **REAR CAMERA** Dual 16 megapixels • **STORAGE** 64GB • **WIRELESS DATA** 4G • **DIMENSIONS** 157x75x7.6mm • **WEIGHT** 165g • **OPERATING SYSTEM** Android 7.0 • **WARRANTY** One year RTB • **DETAILS** [www.hihonor.com](http://www.hihonor.com) • **PART CODE** 51092ADQ • **FULL REVIEW** Apr 2018

### GOOGLE Pixel 3

★★★★★

£570 SIM-free; £33-per-month contract • [store.google.com](http://store.google.com) (SIM-free); [www.mobilephonesdirect.co.uk](http://www.mobilephonesdirect.co.uk) (contract)

**COMPUTER SHOPPER**  
BEST BUY

Pure Android quality on a powerful handset with one of the best smartphone cameras ever. The larger display is also the best-looking of any Pixel phone yet.



**PROCESSOR** Quad-core 2.8GHz Qualcomm Snapdragon 845 • **SCREEN SIZE** 5.5in • **SCREEN RESOLUTION** 2,160x1,080 • **REAR CAMERA** 12.2 megapixels • **STORAGE** 64GB • **WIRELESS DATA** 4G • **DIMENSIONS** 146x68x7.9mm • **WEIGHT** 148g • **OPERATING SYSTEM** Android 9.0 • **WARRANTY** One year RTB • **DETAILS** [store.google.com](http://store.google.com) • **PART CODE** Pixel 3 • **FULL REVIEW** Feb 2019

### APPLE iPhone XR

★★★★★

£709 SIM-free; £45-per-month contract • [www.debenhamsplus.com](http://www.debenhamsplus.com) (SIM-free); [www.tescomobile.com](http://www.tescomobile.com) (contract)

**COMPUTER SHOPPER**  
RECOMMENDED

It's still expensive, but the XR matches the performance of the iPhone XS and XS Max, despite costing hundreds of pounds less, and it has a fantastic camera and display.



**PROCESSOR** Hexa-core Apple A12 Bionic • **SCREEN SIZE** 6.1in • **SCREEN RESOLUTION** 1,792x828 • **REAR CAMERA** 12 megapixels • **STORAGE** 64GB • **WIRELESS DATA** 4G • **DIMENSIONS** 151x76x8.3mm • **WEIGHT** 194g • **OPERATING SYSTEM** iOS 12 • **WARRANTY** One year RTB • **DETAILS** [www.apple.com](http://www.apple.com) • **PART CODE** iPhone XR • **FULL REVIEW** Mar 2019

### XIAOMI Pocophone F1

★★★★★

£299 SIM-free; £22-per-month contract • [www.ebuyer.com](http://www.ebuyer.com); [www.mobilephonesdirect.co.uk](http://www.mobilephonesdirect.co.uk) (contract)

**COMPUTER SHOPPER**  
BEST BUY

The Pocophone F1, one of Xiaomi's first smartphones to get a proper UK release, is a phenomenal bargain: it has the same Snapdragon 845 chip as a lot of premium handsets, plus dual rear cameras, 64GB of storage and a 6.2in screen, all for a mid-range price.



**PROCESSOR** Octa-core 2.8GHz Qualcomm Snapdragon 845 • **SCREEN SIZE** 6.2in • **SCREEN RESOLUTION** 2,246x1,080 • **REAR CAMERA** 12 megapixels, 5 megapixels • **STORAGE** 64GB • **WIRELESS DATA** 4G • **DIMENSIONS** 156x75x9mm • **WEIGHT** 180g • **OPERATING SYSTEM** Android 8.1 • **DETAILS** [www.mi.com/uk](http://www.mi.com/uk) • **PART CODE** MZB6715EN • **FULL REVIEW** Mar 2019



# Choosing a... Tablet

**01** All tablets rely on an operating system (OS) to run apps. You have three main choices: Apple's iOS, which runs on the iPad; Android, which Google licenses to various manufacturers; and Windows 10, which has become common in hybrid tablets and convertibles. If you own an Apple or Google smartphone, you can download your apps, music and so on to a tablet that runs the same OS, so it makes sense to stick with a compatible device.

**02** It's important to pick a tablet that has a good-quality, high-resolution screen. Many budget tablets have 1,280x800-resolution displays, but better tablets have Full HD 1,920x1,080 panels, and we're

starting to see tablets that have even higher screen resolutions. Some are as high as 2,560x1,600 or even 4K. Entry-level tablets typically use TN panels, which don't have particularly good viewing angles. The viewing angles of IPS panels are much better.

**03** If you want to listen to music, watch films and play games, make sure your tablet has plenty of storage. Many tablets come with 8GB or 16GB of internal storage, although some budget models have less. You'll typically pay more for a higher storage capacity. Many tablets also have microSD slots that let you add extra storage, although you won't find one on an iPad. This is a cheap way of boosting storage capacity.

**04** Tablets rarely include a SIM card slot. This means you'll have to rely on Wi-Fi to get online, although some tablets let you access the internet through your smartphone. If you want mobile access to the internet, look for 3G- and 4G-ready devices. These almost always cost more than Wi-Fi-only models, but they're great if you use your tablet while commuting or travelling.

**05** Your choice of tablet determines the apps you can use on it. You may find that some of the apps you want are available on iOS but not Android, and vice versa. Windows 10, meanwhile, runs traditional desktop applications.

## TABLETS

### SAMSUNG Galaxy Book 10.6in

★★★★★

£739 • [amzn.to/2VE6lqz](http://amzn.to/2VE6lqz)

**COMPUTER SHOPPER**  
RECOMMENDED

Good budget 2-in-1s are rare, but Samsung hits the mark with its 10.6in Galaxy Book. The Full HD touchscreen display looks great and, unlike with the iPad Pro or Surface Pro ranges, the excellent keyboard and stylus peripherals come included in the box.



**PROCESSOR** Dual-core Intel Core m3-7Y30 • **SCREEN SIZE** 10.6in • **SCREEN RESOLUTION** 1,920x1,280 • **REAR CAMERA** None • **STORAGE** 64GB • **WIRELESS DATA** No • **DIMENSIONS** 261x179x8.9mm • **WEIGHT** 650g • **OPERATING SYSTEM** Windows 10 Home • **WARRANTY** Two years RTB • **DETAILS** [www.samsung.com/uk](http://www.samsung.com/uk) • **PART CODE** SM-W620NZKAXAR • **FULL REVIEW** Nov 2017

### APPLE iPad (2018)

★★★★★

£319 • [www.apple.com/uk](http://www.apple.com/uk)

**COMPUTER SHOPPER**  
RECOMMENDED

Apple has recalibrated its focus for the latest iPad, keeping the existing design but turning it into an education aid with Apple Pencil support and the Smart Annotation software feature. Even if you're not a teacher or in education, it's still a powerful tablet at a decent price.



**PROCESSOR** Quad-core Apple A10 Fusion • **SCREEN SIZE** 9.7in • **SCREEN RESOLUTION** 2,048x1,536 • **REAR CAMERA** 8 megapixels • **STORAGE** 32GB • **WIRELESS DATA** None • **DIMENSIONS** 240x170x7.5mm • **WEIGHT** 469g • **OPERATING SYSTEM** iOS 11 • **WARRANTY** One year RTB • **DETAILS** [www.apple.com/uk](http://www.apple.com/uk) • **PART CODE** iPad • **FULL REVIEW** Aug 2018

### APPLE iPad Pro 10.5in

★★★★★

£600 • [www.amzn.to/2Cq42f3](http://www.amzn.to/2Cq42f3)

**COMPUTER SHOPPER**  
BEST BUY

While it's still stuck with a mobile OS, rather than the productivity-friendly macOS, there's no arguing with the latest iPad Pro's raw power. An A10X Fusion chip makes it much faster than the 9.7in model in both multitasking and single-threaded applications.



**PROCESSOR** Hexa-core 2.36GHz Apple A10X Fusion • **SCREEN SIZE** 10.5in • **SCREEN RESOLUTION** 2,224x1,668 • **REAR CAMERA** 12 megapixels • **STORAGE** 64/256/512GB • **WIRELESS DATA** 4G (cellular version) • **DIMENSIONS** 251x174x6.1mm • **WEIGHT** 469g • **OPERATING SYSTEM** iOS 11 • **WARRANTY** One year RTB • **DETAILS** [www.apple.com/uk](http://www.apple.com/uk) • **PART CODE** 9.7in iPad Pro • **FULL REVIEW** Oct 2017

### MICROSOFT Surface Go

★★★★★

£509 • [www.microsoft.com](http://www.microsoft.com)

**COMPUTER SHOPPER**  
RECOMMENDED

If you've been craving a tablet with the flexibility of a Surface Pro, without the usual expense, the Surface Go is a perfect fit. It's smaller and uses a less powerful Intel Pentium CPU, but it's still a much more work-ready 2-in-1 than any Android slate.



**PROCESSOR** Dual-core 1.6GHz Intel Pentium 4415Y • **SCREEN SIZE** 10in • **SCREEN RESOLUTION** 1,800x1,200 • **REAR CAMERA** 8 megapixels • **STORAGE** 128GB • **WIRELESS DATA** No • **DIMENSIONS** 245x175x8.3mm • **WEIGHT** 522g • **OPERATING SYSTEM** Windows 10 S • **WARRANTY** One year RTB • **DETAILS** [www.microsoft.com](http://www.microsoft.com) • **PART CODE** MCZ-00002 • **FULL REVIEW** Jan 2019

### SAMSUNG Galaxy Tab S3

★★★★★

£421 • [www.ebuyer.com](http://www.ebuyer.com)

**COMPUTER SHOPPER**  
BEST BUY

Yes, it's incredibly expensive for an Android slate, but the Galaxy Tab S3 is pure luxury: the AMOLED display looks exquisite, the stereo speakers sound great, and Samsung's S Pen stylus is included as standard.



**PROCESSOR** Quad-core 2.2GHz Qualcomm Snapdragon 820 • **SCREEN SIZE** 9.7in • **SCREEN RESOLUTION** 2,048x1,536 • **REAR CAMERA** 13 megapixels • **STORAGE** 32GB • **WIRELESS DATA** None (4G optional) • **DIMENSIONS** 2937x169x6mm • **WEIGHT** 429g • **OPERATING SYSTEM** Android 7.0 • **WARRANTY** One year RTB • **DETAILS** [www.samsung.com/uk](http://www.samsung.com/uk) • **PART CODE** SM-T820 • **FULL REVIEW** Aug 2017

### AMAZON Kindle Oasis (2017)

★★★★★

£230 • [www.amzn.to/2iz8Cge](http://www.amzn.to/2iz8Cge)

**COMPUTER SHOPPER**  
BEST BUY

The premium instalment of Amazon's eReader line is back with a bigger screen, ambient light sensor and IPX8 waterproofing, though its most interesting improvement is the ability to play Audible Audiobooks.



**PROCESSOR** Not stated • **SCREEN SIZE** 7in • **SCREEN RESOLUTION** 300dpi • **REAR CAMERA** None • **STORAGE** 8GB • **WIRELESS DATA** Optional 3G • **DIMENSIONS** 159x141x8.3mm • **WEIGHT** 194g • **OPERATING SYSTEM** Kindle OS • **WARRANTY** One year RTB • **DETAILS** [www.amazon.co.uk](http://www.amazon.co.uk) • **PART CODE** Kindle Oasis (2017) • **FULL REVIEW** Mar 2018



# Choosing a... TV

**01** A 32in Full HD TV costs around £200, but premium larger 4K models can be closer to £2,000. TVs look much smaller in the shop than in your home, so measure the space available before you buy.

Curved TVs are becoming increasingly more common, but bear in mind that these typically take up more floor space than a traditional flat set.

**02** A 1,920x1,080-resolution TV can display a 1080p image. You can still buy TVs with a 720p (1,366x768) resolution, but they're no cheaper and the image won't be as sharp. 3,840x2,560 Ultra HD resolution, or 4K, TVs are finally available at reasonable prices, although you'll still pay a premium for one over a 1080p model.

**03** Consider the number of inputs you'll need to connect the rest of your equipment. Two HDMI ports should be the bare minimum, but many TV sets come with four HDMI connectors. You'll need HDMI 2.0 if you want a future-proof 4K TV, as this is the only way to get 60fps video playback from external sources at such a high resolution.

If you want to plug a PC into your TV, you'll need to use either HDMI or VGA inputs. Be aware that some TVs only let you use a PC on an analogue input, and others won't display the Windows desktop at the TV's highest resolution.

**04** The contrast ratio tells you the difference between the darkest

and the brightest shades that the screen will be able to display. The higher the number, the darker the blacks and the brighter the whites. Buy a TV with High Dynamic Range (HDR) support for the best picture from supported services.

**05** HD content is now becoming fairly widespread, but if you want Ultra HD content your options are more limited. Most Ultra HD TVs have Netflix built into their smart TV systems, but only BT is currently providing live Ultra HD video, with BT Sport Ultra HD.

Ultra HD Blu-ray players give you an amazing picture, and Amazon's Fire TV set-top box will stream its Prime Video service and Netflix at Ultra HD resolutions.

## HOME CINEMA

### PHILIPS 55PUS6753/12

★★★★★

£449 • [www.amzn.to/2HwzUka](http://www.amzn.to/2HwzUka)

**COMPUTER SHOPPER**  
RECOMMENDED

This Philips set doesn't have the best

implementation of HDR we've seen on a TV, but otherwise, the 55PUS6753/12 is a fantastic 4K screen for a relatively low price.



SCREEN SIZE 55in • NATIVE RESOLUTION 3,840x2,160 • VIDEO INPUTS 3x HDMI, 5x component • TUNER Freeview HD • DIMENSIONS 781x1,244x266mm • WARRANTY One year RTB • DETAILS [www.philips.co.uk](http://www.philips.co.uk) • PART CODE 55PUS6753/12 • FULL REVIEW Dec 2018

### SAMSUNG HW-N850

★★★★★

£899 • [www.box.co.uk](http://www.box.co.uk)

**COMPUTER SHOPPER**  
BEST BUY

There's no ultra-high-tech trickery

here: just a soundbar, subwoofer and their combined 14 drivers blasting out pristine-quality audio, with Samsung's usual high standards for connectivity.



SPEAKERS 14 • RMS POWER OUTPUT 372W • DIMENSIONS 1,230x83x136mm (soundbar), 203x400x416mm (subwoofer) • NETWORKING 802.11n Wi-Fi, Bluetooth • WARRANTY One year RTB • DETAILS [www.samsung.com/uk](http://www.samsung.com/uk) • PART CODE HW-N850 • FULL REVIEW Feb 2019

### SONY KD-55XF9005

★★★★★

£999 • [www.johnlewis.com](http://www.johnlewis.com)

**COMPUTER SHOPPER**  
RECOMMENDED

Direct-lit backlighting, excellent upscaling and beautifully smooth motion make the KD-55XF9005 a worthy alternative to high-end OLED TVs, even though it only has a VA panel.



SCREEN SIZE 55in • NATIVE RESOLUTION 3,840x2,160 • VIDEO INPUTS 4x HDMI • TUNER Freeview HD • DIMENSIONS 771x1,228x258mm • WARRANTY One year RTB • DETAILS [www.sony.co.uk](http://www.sony.co.uk) • PART CODE KD-55XF9005 • FULL REVIEW Aug 2018

### PANASONIC DMP-UB900

★★★★★

£319 • [www.hifonix.co.uk](http://www.hifonix.co.uk)

**COMPUTER SHOPPER**  
RECOMMENDED

Together with the Samsung UBD-K8500, this forms the vanguard of a new breed of Ultra HD Blu-ray players. Samsung's model is cheaper, but the DMP-UB900 has superior features, particularly where audio delivery is concerned.



BLU-RAY PROFILE 6.0 • 3D CAPABLE Yes • DIMENSIONS 435x199x68mm • NETWORKING Ethernet, 802.11ac Wi-Fi • WARRANTY One year RTB • DETAILS [www.panasonic.co.uk](http://www.panasonic.co.uk) • PART CODE DMP-UB900EB • FULL REVIEW Aug 2016

### PHILIPS 65OLED803

★★★★★

£2,799 • [www.currys.co.uk](http://www.currys.co.uk)

**COMPUTER SHOPPER**  
RECOMMENDED

If you've got the budget for an OLED TV, this is a great pick. The panel technology's built-in strengths, such as perfect blacks and wide viewing angles, are aided by Philips' exemplary image processing engine, resulting in truly wonderful picture quality.



SCREEN SIZE 65in • NATIVE RESOLUTION 3,840x2,160 • VIDEO INPUTS 4x HDMI, 1x Component • TUNER Freeview HD • DIMENSIONS 824x1,449x280mm • WARRANTY One year RTB • DETAILS [www.philips.co.uk](http://www.philips.co.uk) • PART CODE 65OLED803/12 • FULL REVIEW Apr 2019

### SONOS Beam

★★★★★

£399 • [www.sonos.com](http://www.sonos.com)

**COMPUTER SHOPPER**  
RECOMMENDED

The Beam could join a home cinema setup on sound quality alone, but it's loaded with smart features, too. It can adjust sound output to the size and layout of a room, for example, and form a multiroom system with other Sonos speakers.



SPEAKERS 5 • RMS POWER OUTPUT Not stated • DIMENSIONS 651x100x69mm • WEIGHT 2.8kg • DOCK CONNECTOR None • NETWORKING 802.11ac Wi-Fi, Ethernet • WARRANTY One year RTB • DETAILS [www.sonos.com](http://www.sonos.com) • PART CODE BEAM1UK1 • FULL REVIEW Apr 2019



# Choosing a... Bluetooth speaker

**01** Bluetooth speakers come in all shapes and sizes, so you'll need to decide what you want to do with the speaker before you buy. If you don't plan to take your music outdoors or around the house, look for a wired speaker. These are typically cheaper than speakers with built-in batteries.

If you do want a portable speaker, however, pay particular attention to how much it weighs. Ruggedised models should be able to survive accidental drops, water spills and unexpected rain showers.

**02** Many of the cheapest Bluetooth speakers use the lossy A2DP Bluetooth protocol, which is prone to compressing your music and discarding detail compared with the original recording.

It's hard to tell the difference when listening to pocket-sized speakers, but if you're looking for a speaker to fill a room, an aptX-compatible device is a better option. This Bluetooth protocol retains more detail than the A2DP profile, although you'll need to use it with a compatible smartphone in order to get the benefits.

**03** As with any audio product, the number and size of speaker drivers can have a significant impact on the quality of sound you get from a Bluetooth speaker. Typically, the presence of multiple drivers enables the manufacturer to tune each one for specific frequencies, directing high-end sounds towards a tweeter and sending the mid-range frequencies to the main driver.

Single-driver speakers with larger driver cones can be just as capable of producing fantastic audio, however.

**04** Most Bluetooth speakers have at least one auxiliary input for a wired 3.5mm audio jack, in case you want to listen to music from a device that doesn't have Bluetooth.

There are other extra features to look out for, though. Speakers with built-in batteries may have a USB port for charging your smartphone, or a built-in microphone to turn it into a speakerphone when a paired smartphone receives a call. Not all speakers have physical controls; many rely on your paired device's controls for adjusting the volume or muting playback.

## AUDIO

### CREATIVE Outlier Air

★★★★★

£75 • [uk.creative.com](http://uk.creative.com)

**COMPUTER SHOPPER**  
BEST BUY

A marvellous set of true wireless



NEW ENTRY

headphones, the Outlier Air combine a lively and dynamic sound with a comfy (if large) design and long battery life. Bluetooth aptX support is worth the money in particular.

HEADPHONES SUBTYPE In-ear headset • PLUG TYPE None • WEIGHT 10g • CABLE LENGTH N/A • WARRANTY Two years RTB • DETAILS [uk.creative.com](http://uk.creative.com) • PART CODE Outlier Air • FULL REVIEW Jul 2019

### SONY WH-1000XM3

★★★★★

£272 • [www.amzn.to/2HHUG1J](http://www.amzn.to/2HHUG1J)

**COMPUTER SHOPPER**  
BEST BUY

Bose's QuietComfort headphones have at last been toppled from the ANC



throne. The WH-1000XM3 headphones don't just sound outstanding, with very effective noise cancellation, but they're smartly designed and come with a host of extras.

HEADPHONES SUBTYPE Over-ear headset • PLUG TYPE 3.5mm jack plug (optional) • WEIGHT 255g • CABLE LENGTH 1.2m • WARRANTY One year RTB • DETAILS [www.sony.co.uk](http://www.sony.co.uk) • PART CODE WH-1000XM3 • FULL REVIEW May 2019

### Q ACOUSTICS 3010i

★★★★★

£198 • [www.amzn.to/2xi4CsE](http://www.amzn.to/2xi4CsE)

**COMPUTER SHOPPER**  
RECOMMENDED

Louder and more precise than the 3010, these bookshelf speakers



are worth the money. You'll just need to plug them into an external amplifier, like a hi-fi amp or AV receiver.

SPEAKERS 4 • RMS POWER OUTPUT 125W • WEIGHT 4.1kg per speaker • NETWORKING None • WARRANTY One year RTB • DETAILS [www.qacoustics.co.uk](http://www.qacoustics.co.uk) • PART CODE 3010i • FULL REVIEW Nov 2018

### CREATIVE Muvo 2c

★★★★★

£30 • [www.amzn.to/2wzSxB8](http://www.amzn.to/2wzSxB8)

**COMPUTER SHOPPER**  
RECOMMENDED

Considering it's both pocket-sized and dirt cheap, the Muvo 2c's



bass presence and sheer loudness come as a pleasant surprise, and it's water- and dust-resistant as well.

SPEAKERS 1 • RMS POWER OUTPUT Not stated • DOCK CONNECTOR None • NETWORKING Bluetooth 4.2 (SBC) • DIMENSIONS 93x38x67mm • WEIGHT 159g • WARRANTY Two years RTB • DETAILS [uk.creative.com](http://uk.creative.com) • PART CODE 51MF8250AA011 • FULL REVIEW Jul 2018

### UE Boom 3

★★★★★

£130 • [www.amzn.to/2ThounT](http://www.amzn.to/2ThounT)

**COMPUTER SHOPPER**  
BEST BUY

This IP67-rated Bluetooth speaker is a comprehensive upgrade on the Boom 2: it's more durable, looks better, has longer wireless range and sounds even better.



SPEAKERS 4 • RMS POWER OUTPUT Not stated • DOCK CONNECTOR None • NETWORKING Bluetooth (SBC) • DIMENSIONS 184x73x73mm • WEIGHT 608g • WARRANTY Two years RTB • DETAILS [www.ultimateears.com](http://www.ultimateears.com) • PART CODE 984-001360 • FULL REVIEW Jan 2019

### BOWERS & WILKINS 607

★★★★★

£399 • [www.veybridge-audio.co.uk](http://www.veybridge-audio.co.uk)

**COMPUTER SHOPPER**  
RECOMMENDED

Inspired by the classic 600 series, the wired 607s deliver an exciting and enthusiastic sound profile that reveals the tiniest details in every recording.



SPEAKERS 4 • RMS POWER OUTPUT 125W • WEIGHT 4.7kg per speaker • NETWORKING None • WARRANTY One year RTB • DETAILS [www.bowers-wilkins.eu](http://www.bowers-wilkins.eu) • PART CODE 607 • FULL REVIEW Jun 2019



# Choosing a... Media streamer

**01** Media streamers have come a long way from the hard disk-based set-top boxes of a few years ago. They now come in two main forms: flash drive-sized dongles that plug directly into the HDMI port in the back of your TV, and larger microconsoles that sit under it. Whichever model you choose, it will stream content from the internet rather than storing media files locally.

**02** Most streamers use their own operating system, which you can navigate with a bundled remote control, but Google's Chromecast dongle requires a paired smartphone, tablet or laptop to stream content on the big screen. If you're looking to set up Netflix for

someone who doesn't have a smartphone, buy a standalone streamer such as a Roku or Amazon Fire TV device.

**03** A media streamer is only as good as the services it supports, although a device that offers more services won't necessarily offer more high-quality content than a media streamer with fewer channels. Instead, look out for major channels such as Netflix, Amazon Instant Video, BBC iPlayer, Sky Go and YouTube. If any of these are missing, the remaining channels aren't likely to be much cop.

**04** Although nearly all streamers now pull content from the web, they're still capable of playing content stored locally

from a networked PC or NAS device. Not all streamers are capable of playing all media file formats, however. If you have a lot of MKV or MOV files, check that your chosen streamer supports them before you buy. These are typically the file formats devices struggle with the most.

**05** Media streamers aren't just for video, either. Many support online music services including Spotify, Rdio and TuneIn Radio. Others essentially use the same hardware as a smartphone and are capable of running apps or playing games. Some of the most powerful are compatible with dedicated game controllers, but these are typically sold as optional accessories rather than bundled with the streamer.

## VIDEO

### AMAZON Fire TV Stick 4K

★★★★★

£50 • [www.amzn.to/2Y6q8wh](http://www.amzn.to/2Y6q8wh)

**COMPUTER SHOPPER**  
RECOMMENDED

From set-top box to dangling dongle and now an ultra-compact stick, Amazon's 4K media streamer gets sleeker with every generation. It's also been updated with a new remote, which includes a microphone for Alexa voice commands.



**VIDEO OUTPUTS** HDMI 2.0 • **NETWORKING** 802.11ac Wi-Fi • **DIMENSIONS** 108x30x14mm • **STREAMING FORMATS** UPnP, AirPlay, DLNA, Plex • **INTERNET STREAMING SERVICES** Amazon Video, Netflix, BBC iPlayer, ITV Hub, All 4, My5 • **WARRANTY** One year RTB • **DETAILS** [www.amazon.co.uk](http://www.amazon.co.uk) • **PART CODE** Fire TV Stick 4K • **FULL REVIEW** May 2019

### DJI Osmo Pocket

★★★★★

£329 • [www.amzn.to/2vl53Ba](http://www.amzn.to/2vl53Ba)

**COMPUTER SHOPPER**  
RECOMMENDED

A cleverly made alternative to action cameras, the DJI Osmo Pocket isn't intended for extreme sports, but its mechanical stabilisation ensures smooth, great-looking footage for life-logging videos.



**SENSOR** 1/2.3in CMOS • **SENSOR PIXELS** 12 megapixels • **MAXIMUM RECORDING RESOLUTION** 4K (60fps) • **AV CONNECTIONS** USB Type-C • **DIMENSIONS** 122x37x38mm • **WEIGHT** 116g • **WARRANTY** One year RTB • **DETAILS** [www.dji.com](http://www.dji.com) • **PART CODE** CP.ZM.00000097.01 • **FULL REVIEW** Apr 2019

### NVIDIA Shield TV (2017)

★★★★★

£189 • [www.johnlewis.com](http://www.johnlewis.com)

**COMPUTER SHOPPER**  
BEST BUY

A good media streamer/Android games console hybrid made even better by a more comfortable controller, a wider range of streaming sources and smart home integration.



**VIDEO OUTPUTS** HDMI 1.4 • **NETWORKING** 802.11ac Wi-Fi, 10/100/1,000 Ethernet, Bluetooth 4.1 • **DIMENSIONS** 159x98x26mm • **STREAMING FORMATS** Plex, Kodi • **INTERNET STREAMING SERVICES** Netflix, Amazon Instant Video, Google Play Movies and TV, Google Play Music, YouTube, BBC iPlayer • **WARRANTY** Two years repair and replace • **DETAILS** [www.nvidia.co.uk](http://www.nvidia.co.uk) • **PART CODE** 945-12897-2505-000 • **FULL REVIEW** May 2017

### GOPRO Hero 7 Black

★★★★★

£315 • [www.slrhut.co.uk](http://www.slrhut.co.uk)

**COMPUTER SHOPPER**  
BEST BUY

The Yi 4K+ is cheaper, but no other action camera comes close to the video quality of the Hero 7 Black. That's largely down to its new electronic image stabilisation, which keeps footage looking unbeatably smooth.



**SENSOR** 1/2.3in CMOS • **SENSOR PIXELS** 12 megapixels • **MAXIMUM RECORDING RESOLUTION** 4K (60fps) • **AV CONNECTIONS** Micro HDMI • **DIMENSIONS** 45x62x32mm • **WEIGHT** 116g • **WARRANTY** One year RTB • **DETAILS** [www.gopro.com](http://www.gopro.com) • **PART CODE** CHDX-701-RW • **FULL REVIEW** Feb 2019

### APPLE TV 4K

★★★★★

£179 • [www.apple.com/uk](http://www.apple.com/uk)

**COMPUTER SHOPPER**  
RECOMMENDED

This big update adds 4K content (including, for the first time, Amazon Video support). The best part is that if there's a 4K version of content you've previously purchased in HD, Apple will upgrade it free of charge.



**VIDEO OUTPUTS** HDMI 2.0a • **NETWORKING** 802.11ac Wi-Fi, 10/100/1,000 Ethernet • **DIMENSIONS** 35x98x98mm • **STREAMING FORMATS** AirPlay, others via apps • **INTERNET STREAMING SERVICES** iTunes, Apple Music, Netflix, Amazon Instant Video, Now TV, BBC iPlayer, ITV Hub, All 4 • **WARRANTY** One year RTB • **DETAILS** [www.apple.com/uk](http://www.apple.com/uk) • **PART CODE** Apple TV 4K • **FULL REVIEW** Jan 2018

### SAMSUNG Gear 360 (2017)

★★★★★

£155 • [www.amzn.to/2wesOMX](http://www.amzn.to/2wesOMX)

**COMPUTER SHOPPER**  
BEST BUY

Samsung's updated 360° camera improves on the original in every way: it's more portable, supports live video stream, and is no longer limited to Samsung Galaxy phones. Best of all, it's cheaper than the previous model was at launch.



**SENSOR RESOLUTION** Dual 8.4 megapixels • **SENSOR SIZE** Not disclosed • **VIEWFINDER** None • **LCD SCREEN** 0.5in 72x32 PMOLED • **DIMENSIONS** 100x46x45mm • **WEIGHT** 130g • **WARRANTY** One year RTB • **DETAILS** [www.samsung.com/uk](http://www.samsung.com/uk) • **PART CODE** SM-R210NZWABTU • **FULL REVIEW** Oct 2017



# Choosing a... Digital camera

**01** A basic digital camera will suit someone who wants to take pictures to view on their computer and create 7x5in prints. It should cost around £80, but there may be hidden downsides such as slow performance and very basic user controls.

**02** Spend a little more and you'll get a higher resolution. A 16-megapixel sensor has the potential to produce sharp prints up to A3 size, but only if it and the lens are of a suitably high quality. Very high resolutions in compact cameras tend to boost noise more than detail levels, so many of the best models strike a sensible balance by using a 12-megapixel sensor.

Back-illuminated CMOS sensors tend to produce less noise than CCDs, but

check our reviews to find out how a particular model performs.

**03** A 3x zoom lens provides you with reasonable scope for framing your shots, but a larger range can do wonders for your photography. Most compact cameras can manage a 5x zoom, while pocket-size ultra-zoom cameras can provide 24x zoom ranges.

Numbers such as 28-105mm tell you the wide-angle and telephoto limits of the zoom range. Big zooms require optical image stabilisation to avoid blur due to camera shake when zoomed right in.

**04** Most cameras now have a 3in screen. Look out for 900,000-dot resolutions

or higher for a sharper picture. A touchscreen is useful for moving the autofocus point.

**05** Leave some room in your budget for a memory card, as the bundled memory provided with a camera is never enough. A 16GB card costs less than £10. You may also need to buy batteries.

**06** Don't forget that a camera's specification tells you very little about its image quality. You'll need to read our reviews for that. With a compact camera, we believe the user shouldn't have to grapple with complicated controls in order to take great pictures in a range of lighting conditions.

## PHOTOGRAPHY

### SONY RX100 V

★★★★★

£740 • [www.slrhut.co.uk](http://www.slrhut.co.uk)



**COMPUTER SHOPPER**  
RECOMMENDED

It may be small, but the RX100 V is seriously fast, and because it also captures a surprising amount of light, image and video quality are both top-notch.

SENSOR RESOLUTION 20 megapixels • SENSOR SIZE 13.2x8.8mm (1in) • FOCAL LENGTH MULTIPLIER 2.7x • VIEWFINDER Electronic (2,400,000 dots) • LCD SCREEN 3in (1,228,800 dots) • OPTICAL ZOOM (35mm-EQUIVALENT FOCAL LENGTHS) 2.9x (24-70mm) • 35mm-EQUIVALENT APERTURE f/4.9-7.6 • WEIGHT 298g • DIMENSIONS 60x104x41mm • WARRANTY One year RTB • DETAILS [www.sony.co.uk](http://www.sony.co.uk) • FULL REVIEW Apr 2017

### FUJIFILM X-T3

★★★★★

£1,699 • [www.amzn.to/2Fccak5](http://www.amzn.to/2Fccak5)



**COMPUTER SHOPPER**  
RECOMMENDED

A fantastically versatile mirrorless camera, capable of taking perfect stills as much as it is recording high-quality video. There are plenty of pro-level features, too.

SENSOR RESOLUTION 26.1 megapixels • SENSOR SIZE 23.5x15.6mm (APS-C) • FOCAL LENGTH MULTIPLIER 2.7x • VIEWFINDER Electronic (3.69 million dots) • LCD SCREEN 3in (1.04 million dots) • VIEWFINDER MAGNIFICATION (35mm-EQUIVALENT, COVERAGE) 0.75x, 100% • WEIGHT 539g • DIMENSIONS 93x133x59mm • WARRANTY One year RTB • DETAILS [www.fujifilm.com](http://www.fujifilm.com) • FULL REVIEW May 2019

### NIKON Z6

★★★★★

£1,879 • [www.amzn.to/2VAIqcN](http://www.amzn.to/2VAIqcN)



**COMPUTER SHOPPER**  
RECOMMENDED

If you can't quite afford the exemplary Z7, then the Z6 is the perfect alternative. It's every bit the mirrorless all-rounder, and while it has a lower-resolution sensor than the Z7, this allows it to shoot at a faster rate.

SENSOR RESOLUTION 24.5 megapixels • SENSOR SIZE 35.9x23.9mm CMOS • VIEWFINDER Electronic (3.69 million dots) • LCD SCREEN 3.2in (2 million dots) • VIEWFINDER MAGNIFICATION (35mm-EQUIVALENT, COVERAGE) 0.8x, 100% • WEIGHT 1,175g • SIZE (HXWXD) 101x134x68mm • WARRANTY One year RTB • DETAILS [www.europe-nikon.com](http://www.europe-nikon.com) • FULL REVIEW July 2019

### POLAROID Originals OneStep 2

★★★★★

£99 • [www.amzn.to/2DQhr05](http://www.amzn.to/2DQhr05)



**COMPUTER SHOPPER**  
RECOMMENDED

The OneStep 2 brings back the simple joys of instant photography.

Although the stock can get quite pricey, your shots will look just as they would on a classic Polaroid – perfect for sharing or simply sticking to the fridge.

PHOTO SIZE 3.1x3.1in • BATTERY LIFE 15-20 packets of film • PORTS 1x Micro USB • WARRANTY One year RTB • DETAILS [www.polaroidoriginals.com](http://www.polaroidoriginals.com) • FULL REVIEW Jan 2018

### PANASONIC Lumix GH5

★★★★★

£1,399 • [www.wexphotovideo.com](http://www.wexphotovideo.com)



**COMPUTER SHOPPER**  
BEST BUY

This update to the brilliant GH4 can take great photos, but it's video capture where the GH5 truly excels. Its 4K, 60fps footage is crisp enough for serious indie filmmaking, and it supports 10-bit recording and an optional flat colour profile as well.

SENSOR RESOLUTION 20 megapixels • SENSOR SIZE 17.3x13mm • FOCAL LENGTH MULTIPLIER 2x • VIEWFINDER Electronic (3,680,000 dots) • LCD SCREEN 3.2in (1,620,000 dots) • LENS MOUNT Micro Four Thirds • WEIGHT 725g (with kit lens) • DIMENSIONS 98x146x88mm • WARRANTY One year RTB • DETAILS [www.panasonic.com/uk](http://www.panasonic.com/uk) • FULL REVIEW Sep 2017

### PANASONIC Lumix DMC-G80

★★★★★

£699 • [www.jessops.com](http://www.jessops.com)



**COMPUTER SHOPPER**  
BEST BUY

The G80 is ahead of the pack when it comes to video quality, and its stills look great as well. It's more expensive than the preceding G7, but includes a superior 12-60mm kit lens, among other improvements.

SENSOR RESOLUTION 16 megapixels • SENSOR SIZE 17.3x13mm • FOCAL LENGTH MULTIPLIER 2x • VIEWFINDER Electronic (2,360,000 dots) • LCD SCREEN 3in (1,040,000 dots) • LENS MOUNT Micro Four Thirds • WEIGHT 715g with kit lens • DIMENSIONS 79x137x130mm • WARRANTY One year RTB • DETAILS [www.panasonic.com/uk](http://www.panasonic.com/uk) • FULL REVIEW Jul 2017



# Choosing a... Wearable

**01** Wearable tech can include anything from chest-strap heart-rate monitors to augmented reality glasses, but the two most common types are smartwatches and fitness trackers. Both are designed to sit unassumingly on your wrist, and are almost always meant to be used in tandem with a paired smartphone.

**02** Smartwatches are typically more complex and expensive, though more closely resemble a traditional wristwatch. You can use them to receive and reply to text messages and emails, quickly check maps and even play games – like a smartphone, most smartwatches allow you to install your own choice of apps.

**03** Fitness trackers are much more dedicated to healthy pursuits. Step counters, heart-rate monitors and even sleep tracking are all common, and the data collected is fed back to you so you can see how your workout routine or calorie intake is going.

Many smartwatches also contain health-tracking features, but fitness-specific wearables tend to be cheaper, smaller and lighter.

**04** When it comes to battery life, it's important for any wearable to last a full day, but if it's a smartwatch then you can get away with having to charge it overnight. With fitness trackers, it's better if it lasts for several days off

a single charge, so you can wear it to bed and benefit from sleep tracking.

**05** Look out for waterproofing as well. Wearables that don't mind a few lengths of the pool can be used for swimming or just timekeeping, and at the very least we expect a fitness tracker to be able to deal with rain or sweat.

**06** Different smartwatches use different operating systems, which determine which apps you can install on your device, as well as compatibility with smartphones. Android Wear and Tizen smartwatches will work with both Android and iOS phones, but Apple's watchOS will only pair with an iOS handset.

## WEARABLES

### GARMIN Vivosmart 4

★★★★★

£110 • [www.amzn.to/2UYdj4M](http://www.amzn.to/2UYdj4M)

**COMPUTER SHOPPER**  
RECOMMENDED

Comfortable, accurate and not too expensive, the Vivosmart 4 is a fine fitness tracker, albeit one without onboard GPS. It's particularly suited to those who don't already exercise but are looking to improve their overall fitness.



PEDOMETER Yes • HEART-RATE MONITOR Yes • DISPLAY SIZE 0.7in • RESOLUTION 48x128 • OS SUPPORT Android, iOS • BATTERY LIFE Seven days • WARRANTY One year RTB • DETAILS [www.garmin.com](http://www.garmin.com) • PART CODE 010-01995-04 • FULL REVIEW Apr 2019

### APPLE Watch Series 4

★★★★★

£399 • [www.apple.com/uk](http://www.apple.com/uk)

**COMPUTER SHOPPER**  
BEST BUY

The latest Apple Watch is the sleekest and slickest wearable the company has ever made. An edge-to-edge screen and haptic feedback in the crown are just two of the many enhancements.



PEDOMETER Yes • HEART-RATE MONITOR Yes • DISPLAY SIZE 1.78in • RESOLUTION 448x368 • OS SUPPORT iOS • BATTERY LIFE 18 hours • WARRANTY One year RTB • DETAILS [www.apple.com/uk](http://www.apple.com/uk) • PART CODE Apple Watch Series 4 • FULL REVIEW Jan 2019

### POLAR Vantage M

★★★★★

£203 • [www.amzn.to/2HEqMLJ](http://www.amzn.to/2HEqMLJ)

**COMPUTER SHOPPER**  
RECOMMENDED

A much-improved design sees the Vantage M become a sleeker and more comfortable running watch than the preceding M430, and multisport tracking goes a lot deeper, too – there's even swim tracking.



PEDOMETER Yes • HEART-RATE MONITOR Yes • DISPLAY SIZE 1.2in • RESOLUTION 240x240 • OS SUPPORT Android, iOS • BATTERY LIFE 30 hours • WARRANTY One year RTB • DETAILS [www.polar.com](http://www.polar.com) • PART CODE Vantage M • FULL REVIEW May 2019

### FITBIT Inspire HR

★★★★★

£90 • [www.amzn.to/2VsxcRA](http://www.amzn.to/2VsxcRA)

**COMPUTER SHOPPER**  
BEST BUY

There's no better sub-£100 fitness tracker for casual users than this. The Inspire HR's simplicity and stylishness give it immediate appeal, and you'll stay for the top-quality mobile app.



PEDOMETER Yes • HEART-RATE MONITOR Yes • DISPLAY SIZE 0.7in • RESOLUTION 128x72 • OS SUPPORT Android, iOS • BATTERY LIFE Five days • WARRANTY One year RTB • DETAILS [www.fitbit.com](http://www.fitbit.com) • PART CODE FB505RGPK-EU • FULL REVIEW Jul 2019

### FITBIT Versa

★★★★★

£179 • [www.currys.co.uk](http://www.currys.co.uk)

**COMPUTER SHOPPER**  
RECOMMENDED

The Versa is a much more successful smartwatch/fitness tracker hybrid than Fitbit's previous attempt, the Ionic: this is pleasantly lightweight, highly customisable and backed up by an active (and competitive) community of Fitbit users.



PEDOMETER Yes • HEART-RATE MONITOR Yes • DISPLAY SIZE 1.3in • RESOLUTION 300x300 • OS SUPPORT Android, iOS • BATTERY LIFE Four days • WARRANTY One year RTB • DETAILS [www.fitbit.com](http://www.fitbit.com) • PART CODE FB505RGPK-EU • FULL REVIEW Jul 2018

### MOBVOI TicWatch E2

★★★★★

£146 • [www.mobvoi.com](http://www.mobvoi.com)

**COMPUTER SHOPPER**  
RECOMMENDED

At this price, there's simply no better smartwatch/fitness tracker hybrid than the TicWatch E2. Built-in GPS, IP67 waterproofing and an upgraded battery are all on board, and it's more responsive than most Wear 2100 wearables.



PEDOMETER Yes • HEART-RATE MONITOR Yes • DISPLAY SIZE 1.4in • RESOLUTION 400x400 • OS SUPPORT Android, iOS • BATTERY LIFE Two days • WARRANTY One year RTB • DETAILS [www.mobvoi.com](http://www.mobvoi.com) • PART CODE TicWatch E2 • FULL REVIEW Jun 2019



## SOFTWARE

### ADOBE Premiere Pro CC 2019

★★★★★

£20 per month • [www.adobe.com](http://www.adobe.com)



This strong update of Premiere Pro CC adds improved Lumetri Color controls and neat integration with the Premiere Rush mobile app, among other tweaks.

**OS SUPPORT** Windows 10 version 1703 and later, macOS 10.12 and later (10.13 required for hardware acceleration) • **MINIMUM CPU** Intel 6th-gen and later, AMD equivalents • **MINIMUM GPU** Integrated graphics • **MINIMUM RAM** 8GB • **HARD DISK SPACE** 8GB • **DETAILS** [www.adobe.com](http://www.adobe.com) • **PRODUCT CODE** Premiere Pro CC • **FULL REVIEW** Jul 2019



Video-editing software

### KASPERSKY Security Cloud

★★★★★

£50 • [www.kaspersky.co.uk](http://www.kaspersky.co.uk)



It's just as effective as Kaspersky Total Security, but Security Cloud goes a step further by learning your bad security habits and warning you about them.

**OS SUPPORT** Windows 7/8/10, OS 10.11/macOS 10.12, Android 4.1 and later, iOS 10/11 • **MINIMUM CPU** 1GHz • **MINIMUM GPU** None • **MINIMUM RAM** 1GB (32-bit), 2GB (64-bit) • **HARD DISK SPACE** 1,020MB (Windows), 1,110MB (Mac) • **DETAILS** [www.kaspersky.co.uk](http://www.kaspersky.co.uk) • **PRODUCT CODE** Security Cloud • **FULL REVIEW** Jan 2018

Security software

### NORDVPN

★★★★★

£9 per month • [www.nordvpn.com](http://www.nordvpn.com)



There are cheaper VPN services available, but none has the flexibility and multi-level security features of NordVPN. It's become much faster than previous versions, too.

**OS SUPPORT** Windows, macOS, iOS, Android, DD-WRT router • **DETAILS** [www.nordvpn.com](http://www.nordvpn.com) • **PRODUCT CODE** NordVPN • **FULL REVIEW** Sep 2018

Virtual private network

### MICROSOFT Windows 10 April 2018 Update

★★★★★

Free • [www.microsoft.com](http://www.microsoft.com)



Besides some subtle visual tweaks, the latest major update for Windows adds some genuinely useful features, such as Focus Assist and Timeline.

**OS SUPPORT** Windows 10 • **MINIMUM CPU** 1GHz or faster • **MINIMUM GPU** DirectX 9 or later with WDDM 1.0 driver • **MINIMUM RAM** 1GB (32-bit), 2GB (64-bit) • **HARD DISK SPACE** 16GB (32-bit), 20GB (64-bit) • **DETAILS** [www.microsoft.com](http://www.microsoft.com) • **FULL REVIEW** Aug 2018

OS update

### McAfee Internet Security 2019

★★★★★

£8 • [www.amzn.to/2X5sQBL](http://www.amzn.to/2X5sQBL)



Impressively, the 2019 version takes McAfee Internet Security from an industry damp squib to one of the most reliable security suites on the market. Malware detection is vastly improved and performance is better, too.

**OS SUPPORT** Windows 7/8/8.1/10, macOS 10.12 and later; Android 4.1 and later, iOS 10 and later • **MINIMUM CPU** 1GHz • **MINIMUM GPU** DirectX 9 • **MINIMUM RAM** 1GB • **HARD DISK SPACE** 500MB • **DETAILS** [www.mcafee.com](http://www.mcafee.com) • **FULL REVIEW** Apr 2019

Security software

### APPLE macOS 10.14 Mojave

★★★★★

Free • [itunes.apple.com](http://itunes.apple.com)



Mojave's small UI improvements and minor added features would disappoint on their own, but together they add up to a great update. It's free, too, so there's no reason not to make the switch.

**OS SUPPORT** OS X Mountain Lion or later • **MINIMUM CPU** Not stated • **MINIMUM GPU** Integrated graphics • **MINIMUM RAM** 2GB • **HARD DISK SPACE** 12.5GB • **DETAILS** [www.apple.com](http://www.apple.com) • **FULL REVIEW** Jan 2019

OS update

## GAMING

### XBOX One S

★★★★★

£192 • [www.amzn.to/2ylWNCV](http://www.amzn.to/2ylWNCV)



HDR support is great, but it's the 4K Blu-ray player that makes this sleeker, smaller Xbox One really stand out against the competing PS4 Slim.



**PROCESSOR** Octa-core 1.75GHz Jaguar • **RAM** 8GB DDR3 • **FRONT USB PORTS** 1x USB2 • **REAR USB PORTS** 2x USB2 • **STORAGE** 500GB/1TB/2TB • **WARRANTY** One year RTB • **DETAILS** [www.xbox.com](http://www.xbox.com) • **PART CODE** Xbox One S • **FULL REVIEW** Dec 2016

4K games console

### OCULUS Go

★★★★★

£194 • [www.overclockers.co.uk](http://www.overclockers.co.uk)



No longer do you need a decked-out PC or premium smartphone to enjoy VR. The Oculus Go crams all the hardware you need into the headset itself, making virtual reality entertainment as immediate and accessible as it's ever been.



**DISPLAY** LCD • **RESOLUTION** 2,560x1,440 • **REFRESH RATE** 72Hz • **PROCESSOR** Octa-core 2.4GHz Qualcomm Snapdragon 821 • **RAM** 3GB • **WEIGHT** 467g • **DETAILS** [www.oculus.com/go](http://www.oculus.com/go) • **PART CODE** Go 32GB • **FULL REVIEW** Sep 2018

VR headset

### NINTENDO Labo

★★★★★

£60 • [www.very.co.uk](http://www.very.co.uk)



Nintendo's Labo almost defies explanation: it's a combination of video game, cardboard model kit and children's educational tool. What we do know is that it's incredibly innovative, rewarding and great fun.



**AVAILABLE FORMATS** Nintendo Switch • **DISK SPACE** Not stated • **DETAILS** [labo.nintendo.com](http://labo.nintendo.com) • **PART CODE** Nintendo Labo • **FULL REVIEW** Aug 2018

Switch game and peripherals

### SONY PS4 Slim

★★★★★

£250 • [www.argos.co.uk](http://www.argos.co.uk)



Sony has made the PlayStation 4 even better with a slimmer, neater chassis and superior power efficiency. It's as cheap as the PS4 has ever been as well.



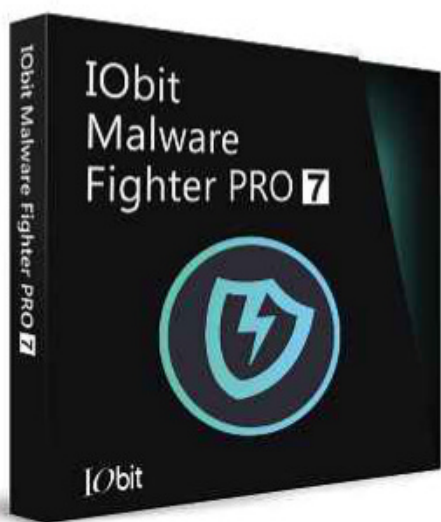
**PROCESSOR** Octa-core 1.6GHz AMD Jaguar • **RAM** 8GB GDDR5 • **FRONT USB PORTS** 2x USB2 • **REAR USB PORTS** None • **STORAGE** 500GB/1TB/2TB • **WARRANTY** One year RTB • **DETAILS** [www.playstation.com](http://www.playstation.com) • **PART CODE** B01GVQVQH2 • **FULL REVIEW** Jan 2017

Games console









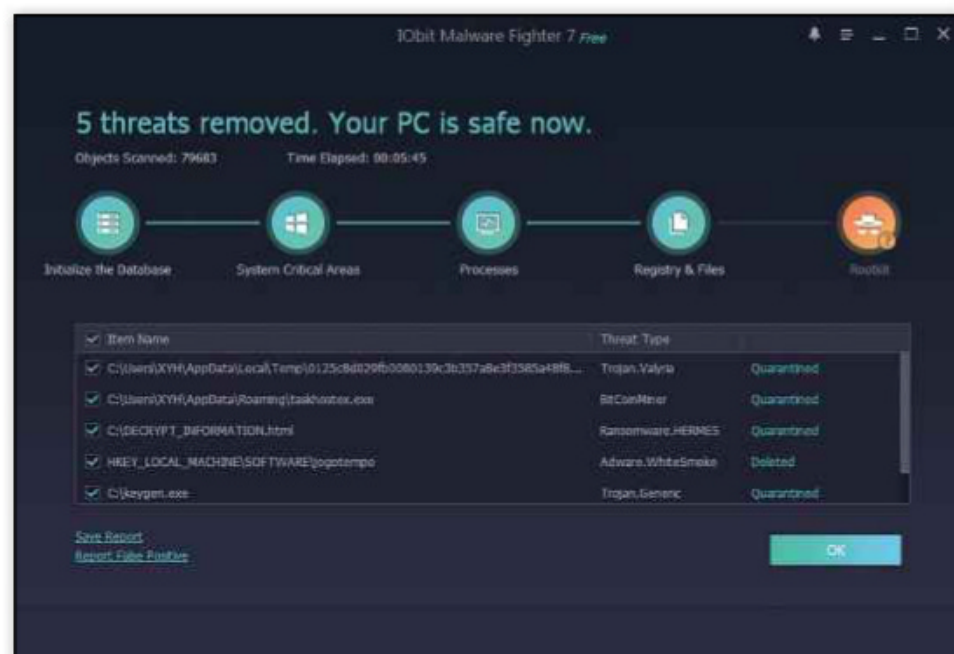
# IObit Malware Fighter Pro 7

**IOBIT MALWARE FIGHTER** is a straightforward anti-spyware tool that can protect your PC in several different ways.

For instance, you can run an on-demand scan to look for spyware, adware, trojans, bots and other threats that your regular antivirus software might have missed. The Smart Scan checks only the most critical areas of your PC, and runs fairly quickly (around seven minutes on our PC); you can run a complete system scan if you prefer, while the Custom Scan allows you to choose exactly what you'd like the program to examine.

Malware Fighter also includes real-time protection in the shape of five dedicated guards, which variously monitor your startup programs, browser settings, cookies, the web pages you view, and the files you access.

Our first brief tests left some questions over the program's accuracy, with Malware Fighter



missing a real threat, and incorrectly warning us of two entirely safe files. It's therefore best used in conjunction with your usual antivirus software, rather than replacing it entirely.

The Pro version, which we're giving you here, adds scheduled scans, protection for USB viruses, process scanning and much more.

**REQUIREMENTS** Windows XP, Vista, 7, 8, 10; 70MB hard disk space  
**WEBSITE** [www.iobit.com](http://www.iobit.com)  
**NOTES** Get your registration code at [mf7.disc.computershopper.co.uk](http://mf7.disc.computershopper.co.uk). Includes a six-month licence

## Dashlane 6 Premium

**THESE DAYS,** A third-party password manager is essential for anyone venturing on to the internet with a clutch of online accounts. You won't last long relying on weak, easily guessable passwords to protect your personal data when online, so password managers such as LastPass that lock all your passwords away behind a single master password have much to recommend them.

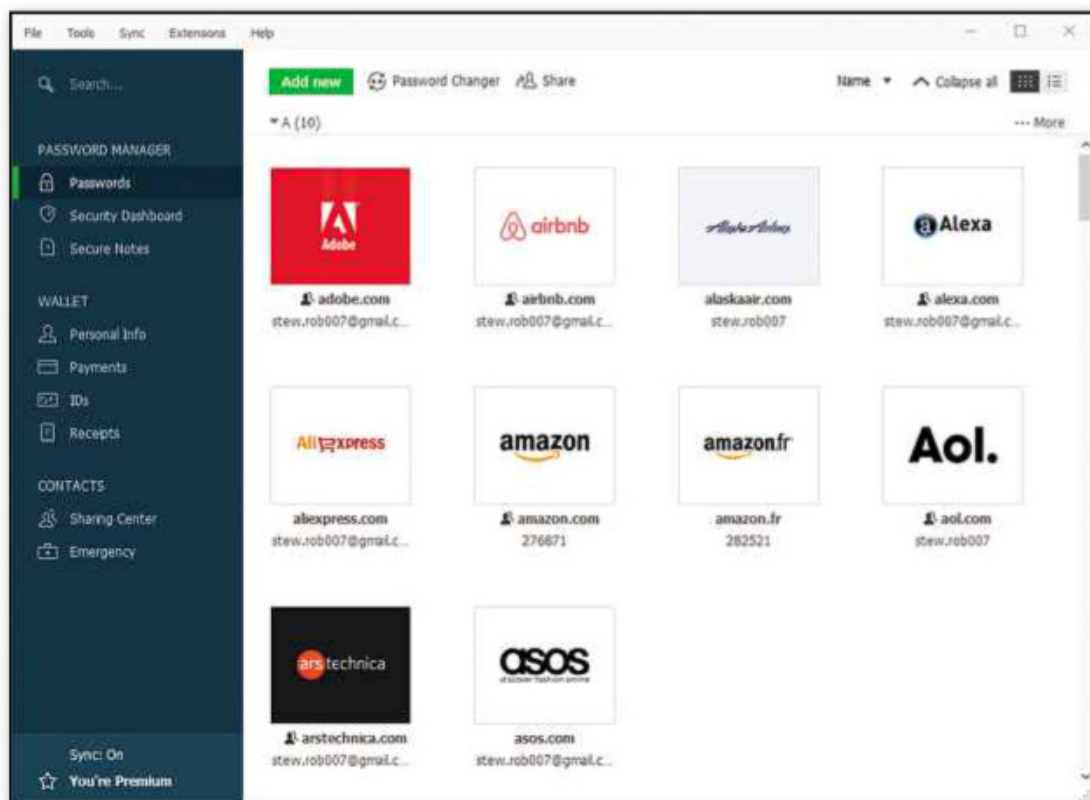
Although Dashlane is not such a well-known password manager, there is a lot to like here, such as AES-256 encryption that derives its key directly from your master password, so it's not stored anywhere. You can also tie your stored passwords to a single device rather than have it securely synced across all your computers and mobiles. You can even tie Dashlane in with Google Authenticator to add another

layer of two-factor authentication for even greater security.

You manage your passwords and digital wallet through a standalone app. This opens at the Security Dashboard, which gives you an overall safety rating based on the strength and repetition of your passwords. You can then track down these passwords and change them to something better, such as a random string of characters generated by Dashlane itself.

Dashlane will alert you when it detects a website has been breached, potentially compromising your account and password on that site, as well as any other sites that share the same password. It's a neat touch and another good reason to give the program a go.

If you're starting out with your first password manager, then Dashlane is a great one to start with. It's robust, helpful and free on mobile as well as desktop.



**REQUIREMENTS** Windows 7, 8, 10; 50MB hard disk space  
**WEBSITE** [www.dashlane.com](http://www.dashlane.com)  
**NOTES** Get your registration code at [dashlane.disc.computershopper.co.uk](http://dashlane.disc.computershopper.co.uk)





# WebSite X5 Go 2019

## WEBSITE X5 GO

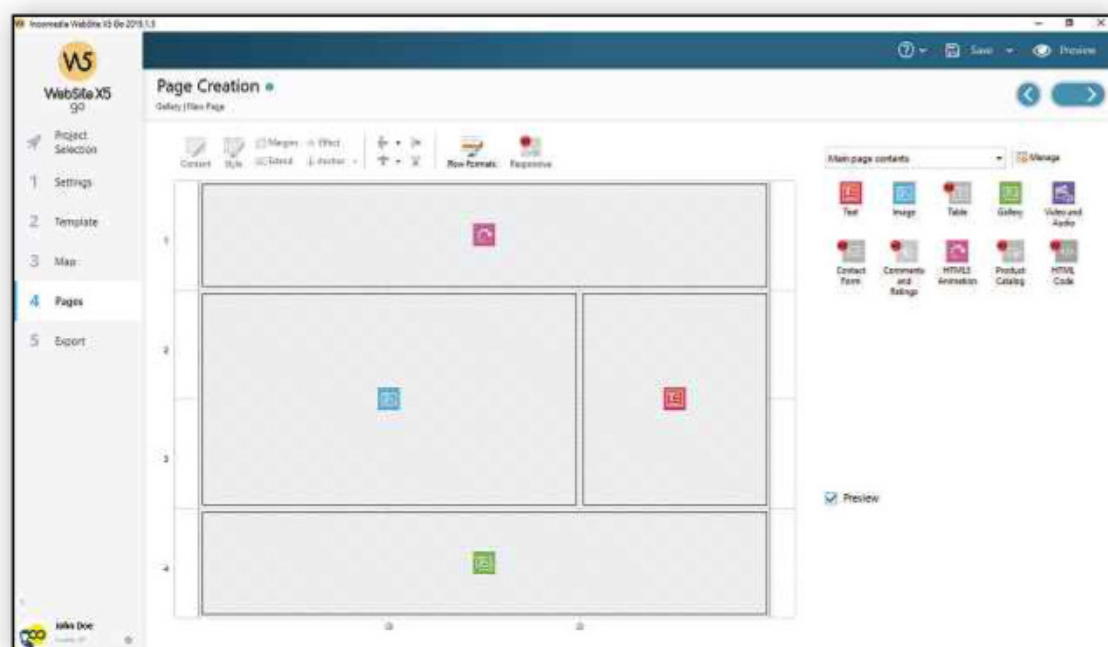
is a powerful application that makes it incredibly easy to create top-quality, responsive websites, even if you have no design or coding experience at all.

The program offers a range of professional templates, covering just about every site type and topic area you can imagine, including e-commerce, blogs, sports sites, animals, food, movies, web portals and more.

Choose a design that appeals, and you can then start planning your site's structure using a map.

From here, it's simply a case of populating each page in turn by dragging and cropping various elements on to your page. Again, there are plenty to choose from, including text blocks, images, galleries, tables, video and audio widgets, maps, Flash animations, product catalogues, email forms and more.

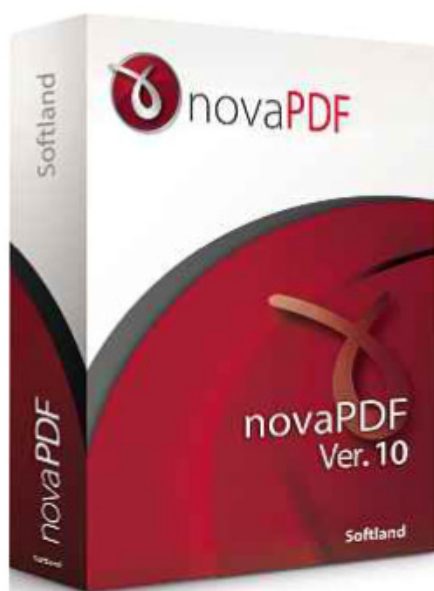
Each element can be styled in many different ways, for a more personal touch. WebSite X5



doesn't just embed an image, for instance – you're able to define a quality setting and resize method, apply a host of smart mouseover effects (including zooming in and displaying custom text, for instance), and even use some basic protection to prevent a browser copying an image. Of course, if someone's truly determined to save it they'll quickly find some other way, but regardless, it's a convenient feature.

Your project may be previewed at any time, whether to judge its progress or to give it a final check over, or it can be uploaded via a built-in FTP engine for more testing.

**REQUIREMENTS** Windows 7 SP1, 8, 10;  
300MB hard disk space  
**WEBSITE** [www.websitex5.com](http://www.websitex5.com)  
**NOTES** Register through the software



# Softland NovaPDF 10 Lite

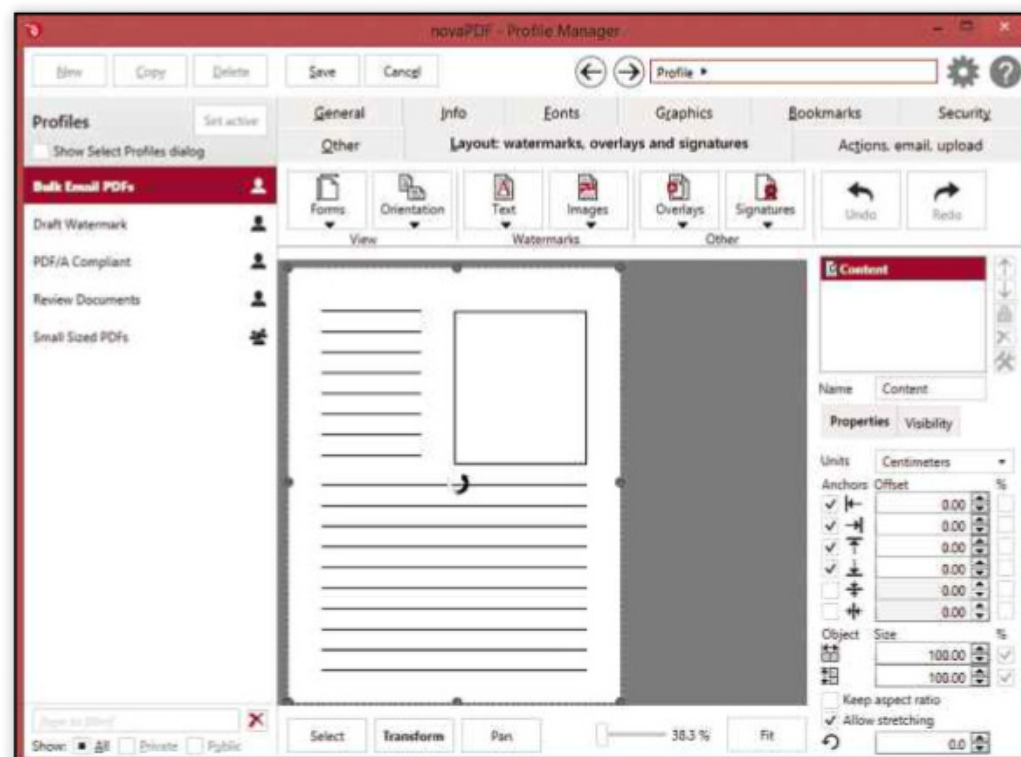
**NOVAPDF IS A** powerful commercial tool for creating PDF files. Install the program and it equips your PC with a virtual printer driver, enabling you to create PDFs from any Windows app. Just open your target document, choose Print, select the NovaPDF printer, and the program will convert it for you.

It also provides its own console, where you can choose a document and convert it to PDF directly.

NovaPDF directly integrates with Microsoft Office applications, too. Open a document, click the NovaPDF tab, and again you can have it converted to PDF in a couple of clicks.

However you start the conversion process, your finished document can be customised in many different ways. Bookmarks, metadata, font embedding, link detection, text optimisation, layout PDF/A and Linear PDF options are all customisable, while a smart Profile system makes it easy to group particular settings together (for example, you might have one profile for home documents, the other for work, then change between the two as required).

It's even possible to define how your finished PDF will be opened later in a PDF viewer, covering anything from hiding menus, toolbars or other interface elements, to configuring particular transition types.



**REQUIREMENTS** Windows XP, Vista, 7, 8, 10;  
10MB hard disk space  
**WEBSITE** [www.novapdf.com](http://www.novapdf.com)  
**NOTES** Get your registration code at [www.novapdf.com/free/creativemarkn19.html](http://www.novapdf.com/free/creativemarkn19.html)



## Chat and Communication

**Evernote 6.17.6.8292** Store your notes, ideas and plans in the cloud, and synchronise them between computers.

**UPDATED Mailbird 2.5.45.0**

A free desktop email client for Windows.

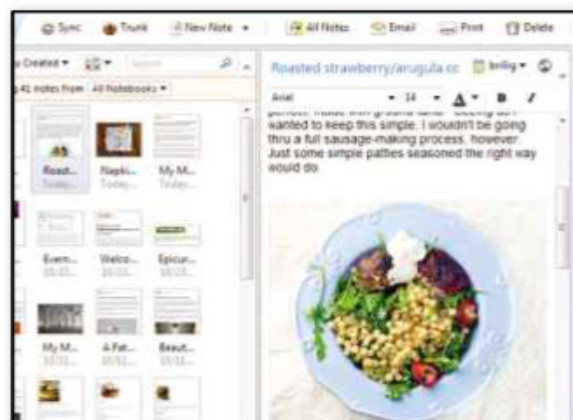
**Miranda IM 0.10.80**

Chat with friends across multiple messaging platforms, including AIM, Facebook, IRC and MSN, all from one simple interface.

**UPDATED Skype for Windows 8.44.0.40** Make internet voice and video calls for free, and buy credit to make calls to mobiles and landlines.

**UPDATED Telegram 1.7.0** This free IM app synchronises your conversations across multiple devices, and can spruce up chats with stickers and GIFs.

**UPDATED WhatsApp Desktop 0.3.2848** A free PC and Mac version of the popular messaging app, letting you chat from your desktop.



## Customisation

**iolo System Mechanic Free 18.6**

Speed up your system with iolo's PC optimisation suite.

**Rainmeter 4.3**

Customise the desktop with your choice of tools and shortcuts.

**Windows 8 Transformation Pack 9.1**

Emulate the look of Windows 8 on an earlier version of the operating system.

**Windows 8 UX Pack 9.1**

Get a glimpse of the Windows 10 UI without committing to a full OS upgrade.

**Windows 10 Transformation Pack 7.0**

Bring some of Windows 10's new features to your current operating system.

**Winstep Xtreme 19.2**

Freshen up your system with this suite of desktop and UI replacement applications.



## General

**Genie Timeline Free 2017 10.0.1.100**

Protect your most valuable files with this easy-to-use backup tool.

**Paragon Partition Manager 16 Free**

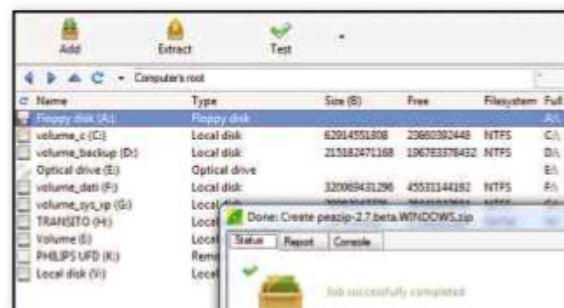
Create, format, split, merge and reorganise all your hard disk's partitions.

**UPDATED PeaZip 6.8.0** A tremendously powerful archive-management tool.

**Screenshot Captor 4.31.2** Create and manage screenshots the easy way.

**UpdateScanner 2.2.0.0** Scan all the software on your PC, find out if an update is available, then install it immediately.

**ZipGenius 6.3.2.3116** A flexible file-compression tool with support for a huge number of compressed file formats.



## Internet and Network

**CarotDAV 1.15.5**

Manage all your online storage services with one simple application.

**Cyberduck 6.9.4**

A powerful but easy-to-use FTP client for uploading and downloading your files.

**Glasswire 2.1.152**

Keep tabs on your network usage with this simple monitor.

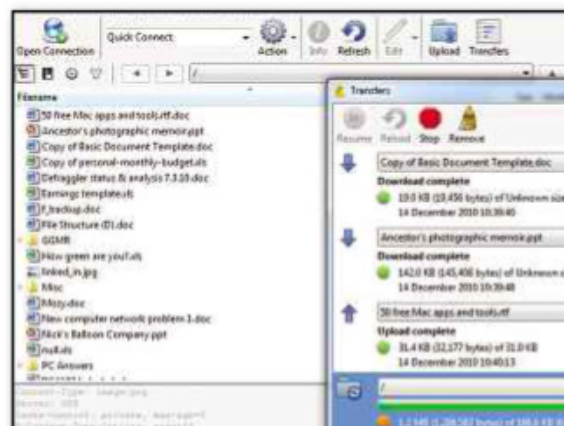
**UPDATED FileZilla 3.42.1** A fast and reliable FTP client with lots of useful features.

**NetBalancer 14.1.18533**

Make the most of your internet connection by assigning download and upload priorities to web applications.

**UPDATED TeamViewer 14.2.8352**

Remotely control your computer from anywhere in the world.



## Tweaking and Performance

**CCleaner 5.56** Remove unwanted information, temporary files, browsing history, huge log files and even the settings that uninstalled software leaves behind.

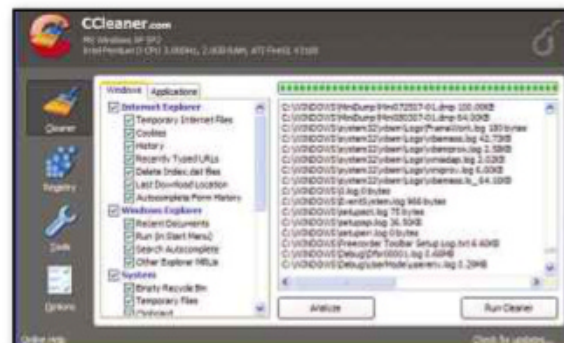
**Defraggler 2.22** Ensure that your system is defragmented properly and improve its performance.

**Finestra Virtual Desktops 2.5.4501** Set up four or more virtual desktops on your PC.

**UPDATED IObit Advanced SystemCare Free 12.3.0.335** A complete computer security, maintenance and optimisation suite.

**Revo Uninstaller Free 2.0.6** Remove installed applications completely, including all their folders, system files and Registry entries.

**Simple Performance Boost 1.0.5** Tweak the Windows Registry to give your PC a performance boost.









# TALK TOME

## THE ULTIMATE GUIDE TO AMAZON ALEXA

**F**rom nothing to being in thousands of homes just a few years later, Amazon Alexa has kickstarted a new range of devices that you can control with just the power of your voice.

While it's easy enough to get started with an Echo smart speaker, fine-tuning it to work the way you want – from delivering the information you need and playing the music from the service you want to making your smart home work better – isn't quite as easy.

In this guide, we'll take you through everything you need to know about Amazon Alexa, and show you how to improve and tweak it. We'll also address the privacy concerns that many people have.

Make the most of Amazon's powerful voice assistant with our guide to setting up, controlling and customising your Alexa devices. **David Ludlow** talks you through all the essentials

### CONTENTS

- Everything you need to know about Alexa ....80
- Best Amazon Alexa Skills .....82
- Control your smart home .....84
- Music and communication.....86



# EVERYTHING YOU NEED TO KNOW ABOUT ALEXA

Once you've got your Echo hooked up to your Amazon account, you can do a lot straight away. Here's everything you need to know about Alexa

**T**here are plenty of Amazon Alexa devices out there, but the core services are all run in the cloud. As such, the hardware defines the sound quality (or picture quality, in some cases), but the main features are the same across all devices, with a few exceptions for third-party smart speakers (see box, opposite). For that reason, our group test of Echo devices on page 88 will help you buy the right hardware, but here, we'll show you what Alexa is capable of.

A good starting point is with the features that are built into Alexa. These are the commands and options you can start with.

## ANSWER ME

At its most basic, Alexa is there to answer any questions you might have. Want to know how to spell a word? Ask Alexa. Want to know the answer to a maths problem? Ask Alexa. Likewise, you can find out which day Christmas or your birthday will fall on. You can ask about IMDB ratings for TV shows and find out who plays certain characters.

In short, if you've got a question, you throw it at Alexa. She'll quite often reply that she doesn't know the answer, but the more questions you ask, the more

you'll get to understand her limitations, and what you can and can't do.

Weather is one of the big reasons to use Alexa: just ask what the weather's like and you'll get an update for your local area. You can also try things like 'Alexa, will it rain?' to get more specific information. If you want weather updates for a different part of the world, just ask and say the name of the city or location you want information for.

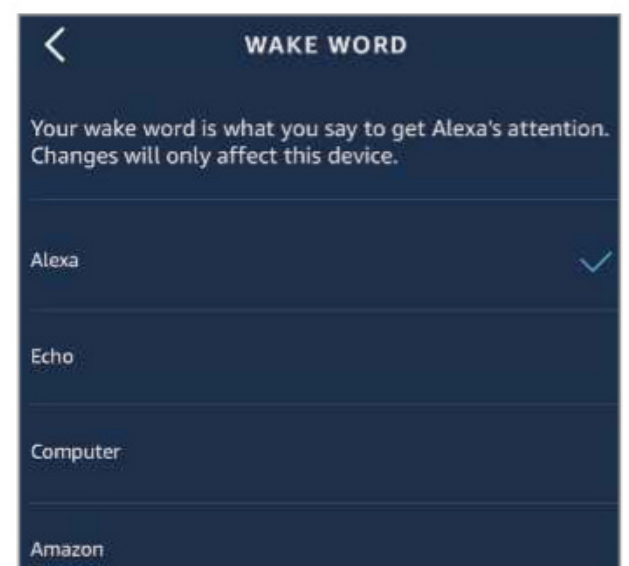
Alexa can also be your best kitchen assistant. You can set a simple or multiple timers, naming them. For example, 'Alexa, set pizza timer 15 minutes. Alexa, set chips timer 12 minutes' will set two timers for different things you're cooking. If you have an Alexa device in your bedroom, you can also set an alarm just by asking.

## TAKE CONTROL

You don't have to stick with the default Alexa settings, and you can make some changes that may make the system easier to deal with. If you find that Alexa goes off by herself all too often, you can change the wake word. Go to the Alexa app and tap Devices, then tap Echo & Alexa for a list of your smart speakers. Tap the speaker you want to edit, tap Wake Word, and you can choose from

the list of options: Alexa, Echo, Computer and Amazon. Each Echo device has to have its wake word changed individually.

By default, after Alexa has answered a question or completed a command, she shuts down and you have to ask her a new question, starting with 'Alexa' (or the wake word you set). With Follow-Up Mode, Alexa waits for you to ask another question for a few seconds. As Follow-Up mode is enabled individually on each smart speaker, follow the instructions above to go to your Echo's Settings page, select Follow-Up mode and toggle it on.

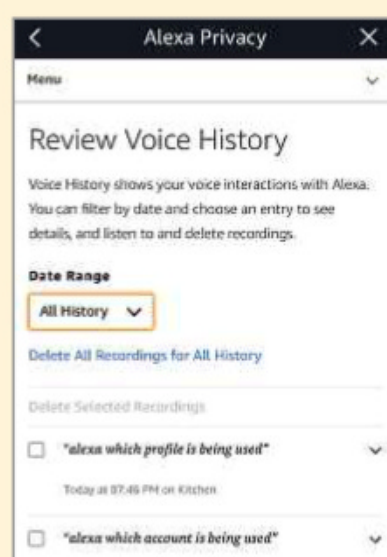


## Is Alexa listening to everything I say?

There have been concerns that Alexa is listening in to everything we say and spying on us. This is only partially true. Amazon only listens in when it thinks it hears the wake word (usually Alexa), although this can be triggered by mistake. Once heard, Amazon then records and stores the requests.

Bloomberg discovered that Amazon had employed staff to listen to these recordings in order to help train Alexa to better understand what's being asked. Fortunately, you can control what information is stored, and even delete past recordings.

First, the more shocking bit: seeing how much data Amazon has recorded about you. Open the Alexa app and go to Settings, Alexa Account, Alexa Privacy. Tap Review Voice History and you'll see a list of phrases that Alexa has heard today. You can select individual ones and delete them, or use the option to delete all recorded conversations for today.



Using the drop-down menu, you can view recordings for different periods, including Yesterday, This Week, This Month and All History. For each option, you can delete individual recordings or delete everything.

From the Alexa Privacy menu, you can also delete (but not see) information on how you've used Alexa to control your smart home devices.

To prevent Alexa from recording information in future, select the Manage How Your Data Improves Alexa option. You can then turn off the options to Help Develop New Features (Amazon warns that new features may not work well for you if you do this, although we can't see how), and you can turn off Use Messages to Improve

Transcriptions to stop any messages you send using Alexa from being read.



## ON LOCATION

If you set a detailed location, Alexa can do a bit more. To change your Echo's location, you have to go to the Alexa app, select Devices, Echo & Alexa, and then pick one of your smart speakers. Select Device Location and then enter your full address, including the street, town and postcode. Each Echo device can have a different address.

Once you've got an address in your account, you can do more with Alexa. For example, ask for traffic on a particular route and you'll get an overview of the situation and the quickest route. It's still not perfect,

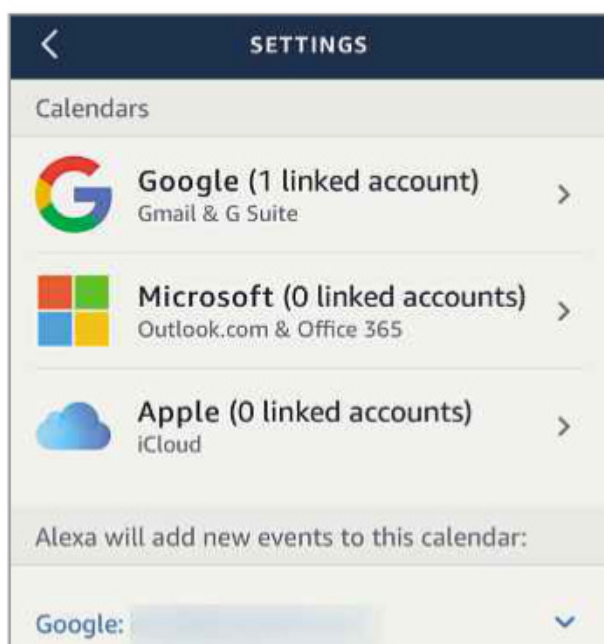


however. For example, if you ask about 'traffic to Heathrow', Alexa will tell you the route and current traffic levels; ask 'how long it takes to drive to Heathrow' and Alexa will tell you the distance but say she can't tell you how long it will take as she doesn't know how fast you're driving.

Local search lets you find local information, such as your nearest Indian restaurant. Alexa's information isn't as detailed as Google's local information, but it is getting better.

## DATE NIGHT

As well as delivering generic information, Alexa can be configured to bring you information from your personal calendars. To set this up, go to the Alexa app and select Settings, Calendar. You can add Google, Microsoft or Apple accounts; if you add more than one, you can set a default.



## What about third-party devices?

**Alexa isn't limited to running on Amazon's Echo devices, and there are plenty of third-party speakers that also have Alexa built in, from the Sonos One music player (page 95) to the Netgear Orbi Voice mesh system (Shopper 376).**

Third-party speakers largely work in the same way as Echo devices. You ask Alexa a question or get her to turn on smart devices, and she responds. As third-party devices are linked to your Amazon account, these speakers get access to all the services and features that you set up. There are some limitations, however.

First, third-party devices currently don't support calling or drop-in between Echo devices, so you can't use them as an alternative to an intercom or a cheap way of making phone calls. Depending on what you want to use your speakers for, this may be too much of a limitation.

Second, not all third-party devices can be placed into groups; the Sonos products are the exception. That may not sound like much of an issue, but it makes controlling smart home devices a little more taxing. Again, what you want to use your smart speakers for will guide your decision, but for the widest range of options you need Amazon Echo devices (see the group test on page 88 for our full recommendations).



Once added, you can then ask Alexa what's coming up in your calendar, or to add a new event for you.

You can further use the Settings part of the app to personalise the assistant by adding in your favourite sports team ('Alexa, what's my sports update?'), and to give you traffic directions to your place of work ('Alexa, what's my traffic?').

## HOW FLASH

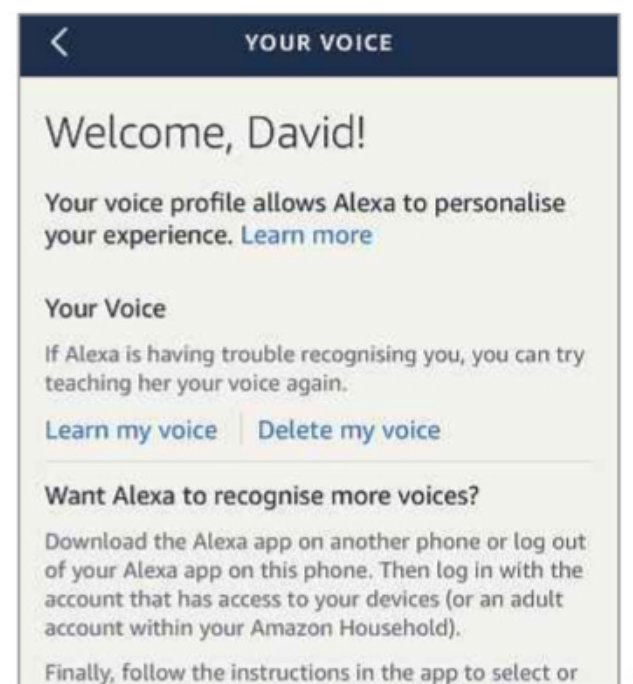
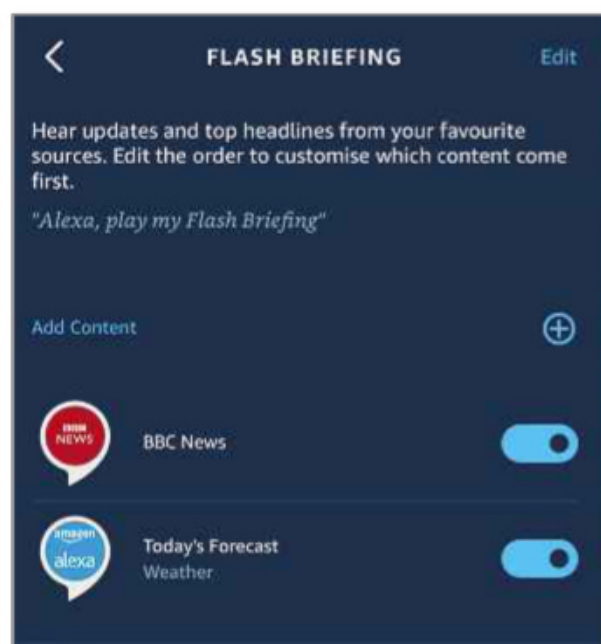
If you want to get a load of information in one go, Alexa has the Flash Briefing ('Alexa, play my Flash Briefing'). To customise it, go to Settings, Flash Briefing. Tap the plus icon to add more sources for your content, such as BBC News. You can adjust the order in which flash briefings play.

## MULTIPLE USERS

Alexa supports multiple users on the same speakers, letting people access their own private information. For each household, you

can have up to two adult users. To manage your users, go to Settings, Alexa Account, Amazon Household. Here, you can invite a second user to your home (they have to have an Amazon account). Once they get the invite and accept it, they should download and install the Alexa app, then they can log into their account. The new user can then add their own calendars, music service and so on.

To switch between accounts, you can say 'Alexa, switch profile' and you can ask, 'Alexa, which profile is being used?' to check. If you want to automate the profile switch, you can use the Recognised Voices option in Settings, Alexa Account. Tap Your Voice, then follow the instructions to repeat phrases to an Echo speaker so that Amazon can learn your voice. The other adult in your home can then do the same thing via their account so that Alexa will automatically personalise results.





# BEST AMAZON ALEXA SKILLS

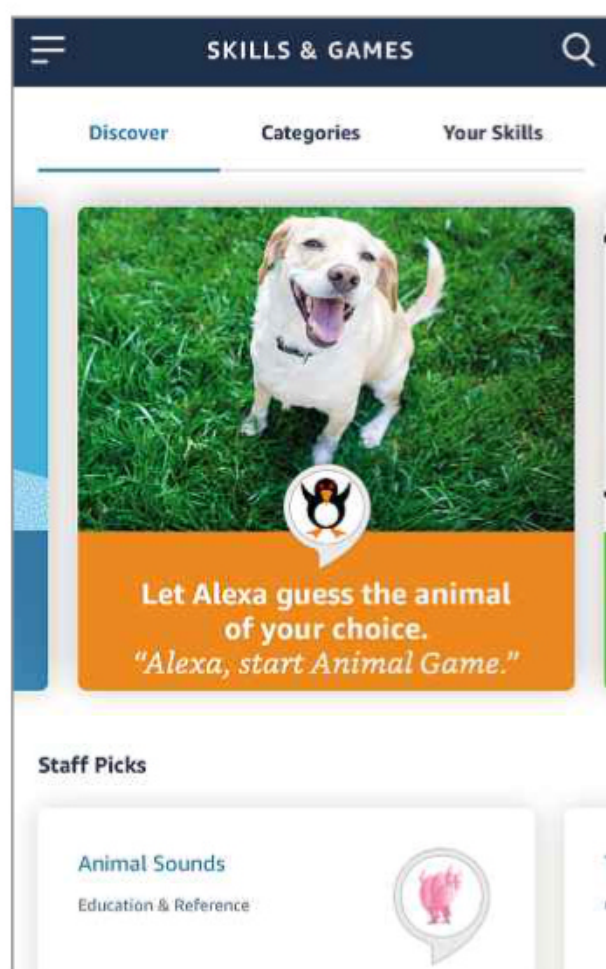
One of the best things about Alexa is the way you can expand its capabilities using Skills. Here we show you how to get started, and pick 10 of our favourites

If you find something that Amazon Alexa can't do, don't panic, as there's probably a Skill that can help you out. Think of these as apps for Alexa, and you'll understand. Skills do everything from giving you control of your smart home devices (see page 84) to giving you travel updates. We'll bring you our list of our favourite ones here, but first we'll cover how to install and manage them.

## INSTALLING AND MANAGING SKILLS

All Skills are managed through the Amazon Alexa app. Open it up and tap the menu icon at the top left of the screen, then select Skills and Games. Here, you can tap the Search icon if you know which Skill you want to look for, or you can tap Categories to browse through the various options.

Skills are rated by other users, just as in the Google Play store, so you can quickly find out which ones are good and which should be avoided. To install a Skill, just tap it and select Enable to use. If required, you'll be prompted to enter any account details, but many don't need any additional information.



To manage the Skills that you have installed, go back to the main Skills and select Your Skills. You can select a Skill that you no longer want and tap Disable Skill to remove it.

## TOP ALEXA SKILLS

Now that you know how to find and install Skills, here's a rundown of our favourite ones to get you started. Just type the name of the Skill into Alexa app's search feature to find them.

### 1 Skill Finder

To help you get started, Skill Finder is a Skill that helps you find and install other Skills. That might sound a bit strange, but Skill Finder has been developed by Amazon and it's there to help you discover more things that your Echo device can do.

One of its top uses is to give you the Skill of the Day, so that you have the option to try out loads of new features (you can decline to install any Skill).

#### Test commands:

- Alexa, tell Skill Finder to give me the Skill of the Day.
- Alexa, tell Skill Finder to give me the newest skills.
- Alexa, tell Skill Finder to give me top skills.

### 2 Find My Phone - TrackR

Are you always losing your phone? Fear not, as with the TrackR skill you can find your handset. First, you need to download the TrackR app on your smartphone (Android or iOS) and then create a free account. Next,



go back to Alexa and install the TrackR Skill and verify your account. Then you can use the Skill to ring your phone so that you can find it when you lose it.

#### Test commands:

- Alexa, ask TrackR to find my phone.
- Alexa, ask TrackR to ring my phone (your phone will start ringing).

### 3 National Rail

With the National Rail Skill, you can ask Alexa for updates to train schedules, estimated times of arrival, and you can also plan a new train journey. This is a Skill that you can open – that is, you start the Skill with the command 'Alexa, launch National Rail' – and then you follow the voice prompts for options. There are direct voice commands, too.



#### Test commands:

- Alexa, ask National Rail to check my commute.
- Alexa, ask National Rail to plan a journey.

### 4 Science Buddy

Science Buddy is a free Skill that can help your kids learn more about science. Each time you launch it, you get 10 questions with three multiple choice answers to pick from. It's a neat and engaging way to learn a bit more. Just say, 'Alexa, launch Science Buddy'.

### 5 Amazon Storytime

Amazon Storytime is a free app that will read your children a short story, performed by a full cast of professional actors. All of





the stories are guaranteed to be safe for your kids to listen to, so there's no danger of 50 Shades being read out.

#### Test commands:

- Alexa, ask Amazon Storytime to tell me a LEGO story.
- Alexa, ask Amazon Storytime to tell me silly stories.
- Alexa, next.
- Alexa, start over.

## 6 Animal Sounds

Want to know what an animal sounds like? Animal Sounds is the Skill for you. Just ask it to play you the sound of an animal and it will come out of your Echo speaker. There's a huge number of animals to choose from, and the list is being added to all the time; it now includes everything from elephants to ants.



#### Test commands:

- Alexa, ask Animal Sounds for a pig sound.
- Alexa, ask Animal Sounds for an ant sound.

## 7 Meat Thermometer

If you're cooking but can't remember what the internal temperature of meat should be

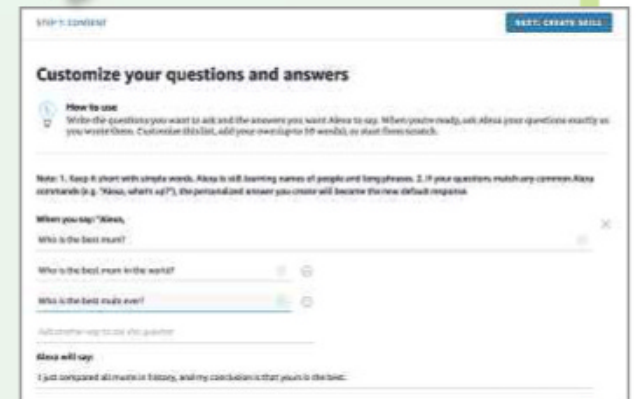


# Make your own Skills with Alexa Blueprints

With Blueprints ([blueprints.amazon.co.uk](http://blueprints.amazon.co.uk)), you can create your very own Skills, using the templates that Amazon provides. The Skills are largely built around the same format – you provide the question that will be asked and the answer you want to give – but are split into useful categories and sub-sections with example rules.

For example, the Houseguest template lets you create simple answers for people staying in your home, such as 'What's the Wi-Fi password' or 'Where is the tea kept?'. Likewise, the Pet Sitter template has questions and answers to do with looking after your pet.

There are other templates to dish out favourite jokes or even insults. And you can create simple quiz games, too, either to entertain or to help with revision. Building your own Blueprint Skill is straightforward and easy, so give it a go.



when it's cooked, the Meat Thermometer Skill is for you. Once enabled, just say, 'Alexa, launch Meat Thermometer'. You'll then be asked which type of meat you're cooking, and you can reply to get the final temperature that you're aiming for.

## 8 Big Sky

Alexa's weather forecasting is rather basic, but Big Sky is far more detailed. It uses the data from the excellent Dark Sky app, which provides hyper-local weather forecasts, including predictions for when it will start or stop raining. Check out the Alexa app for more information on the Skill and configuring it for your address.



#### Test commands:

- Alexa, what's the high temperature today?
- Alexa, will it rain in the next three hours?
- Alexa, what was the weather on 1st June 1980?

## 9 TED Talks

TED Talks now has a huge library of interesting and insightful talks, delivering new ideas from some of the planet's most

engaging talkers. With the TED Talks Skill, you can listen to the catalogue from the comfort of your own living room.

#### Test commands:

- Alexa, ask TED Talks to play the latest talk.
- Alexa, ask TED Talks for something funny.
- Alexa, ask TED Talks to find talks about nature.

## 10 The Bartender

Looking to make some impressive cocktails to impress your guests, or just want a more interesting drink yourself? The Bartender is your complete guide to cocktail making, containing recipes for classics such as an Old Fashioned through to more unusual fare.

#### Test commands:

- Alexa, open the Bartender.
- Alexa, ask the Bartender to pick a drink.
- Alexa, tell the Bartender to surprise me.





# CONTROL YOUR SMART HOME

Alexa makes it easy to control smart devices in your home such as lights and heating using your voice. We show you how to set everything up

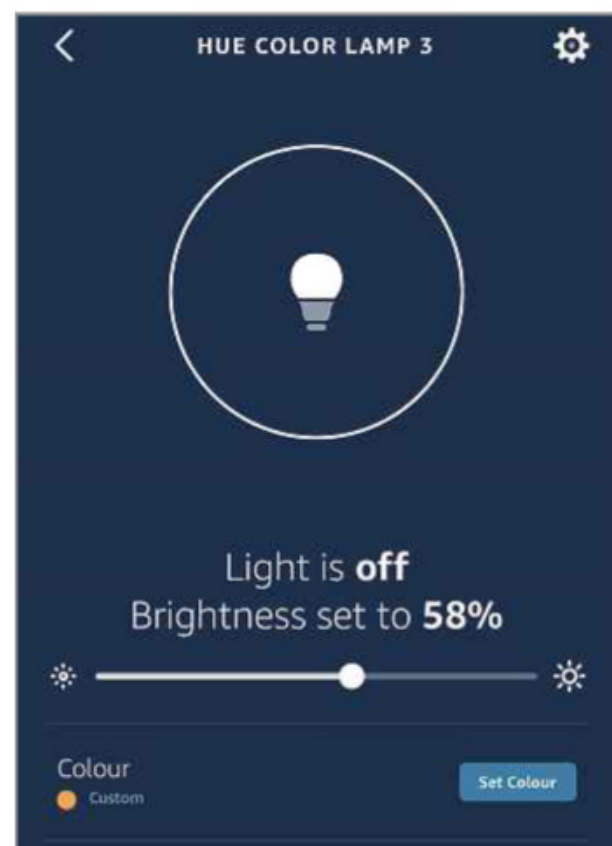
One of the main reasons to use an Echo is to control your smart home devices, turning up the heating or turning off the lights without your having to leave the comfort of your seat or bed. Here's what you need to know.

First, each smart home device requires you to install a Skill in the same way that you'd install the Skills that we listed on the previous page. Typically, you're prompted to log into an account, such as Philips Hue, and then Alexa will discover which devices you have in your home.

Once discovered, what you can do varies from device to device, so check out the Skills page to see what commands you can use. That said, there are some basics. For example with lights, you can say, 'Alexa, turn on <name>' or 'Alexa, set <name> to 50%'. Similarly, with thermostats, you can say, 'Alexa, set <name> to 20 degrees'.

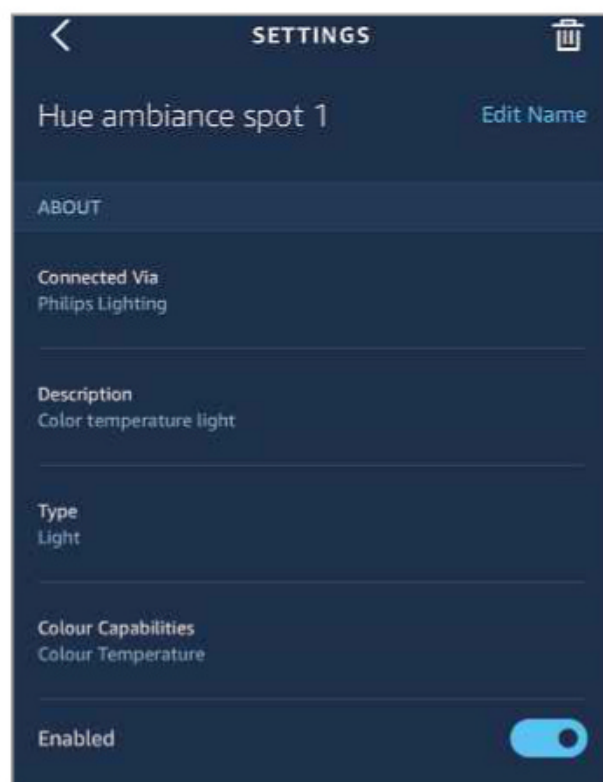
## APP CONTROL

As well as controlling devices using your voice, you can control them using the Alexa app. Open it up and tap the Devices button (bottom right). Here, you'll see a list of device categories, including Echo & Alexa, Lights, Plugs, Thermostats, Locks, Scenes and All Devices. Just select the category you want,



## MAKE ALEXA LESS ANNOYING

Tired of Alexa spouting back a long sentence when you ask something simple? Go to the Alexa app, Settings, Alexa Account, Alexa Voice Responses and turn on Brief Mode. This will get Alexa to give shorter replies or reply with a beep if you ask something simple, such as turning on a light.



such as Lights, and you can then select a device, such as a smart light bulb.

Alexa then gives you controls so you can control your device directly, setting a light's brightness or changing its colour, for instance.

The Device list is also where you manage your devices from. Once you've selected a device, there are two ways of editing it. If the device doesn't have any app controls, then selecting it brings you to the edit screen. If the device does have app controls, such as with a smart light bulb, select the Settings cog to go to the edit screen.

On this screen, you can tap Edit Name to give your device an easier-to-remember (or say) name. Note that this only changes the name for Alexa, not in the parent app. So if you change a Hue bulb's name in Alexa, the old name still appears in the Hue app.

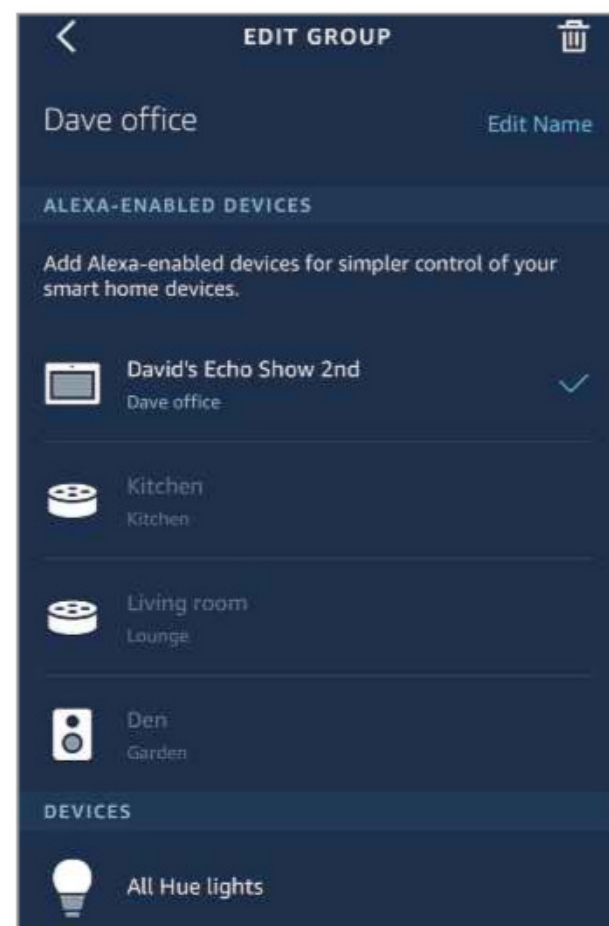
You can also use the Enabled toggle switch to turn off a device temporarily, and use the Bin icon to remove a device from your Echo. If you want to remove a device permanently, you should also go to the device's Skill and disable it there. If you don't, the next time Alexa runs a discovery routine it will bring back your deleted products.

## GROUP THERAPY

So far, so good, but Alexa really comes into its own when you start to use groups to place your smart devices together. Think of Groups as rooms, where you place all devices into their own room. Groups give you two main advantages.

First, you can control all devices in a group together. For example, 'Alexa, turn on kitchen lights' will turn on all smart bulbs in that room. More importantly, you can add an Echo device to a group, telling it where it's located. This means that you no longer need to mention devices by name when you want to control them.

If you were in your kitchen, you could just say to your kitchen Echo, 'Alexa, turn on light'. Alexa then knows that it's in the kitchen, so you want to turn on the lights in the same





# How to create Routines

Routines are Alexa's way of doing multiple things in one go, all under the control of a single command word, time or through the press of a button. For example, you can set up a routine trigger by saying, 'Alexa, goodbye', which will turn off all of your lights and smart plugs – handy if you're always leaving lights on when you go out. Or you could say, 'Alexa, turn on movie mode', which would dim the lights and turn up the thermostat.

The choice on what to do is entirely up to you, but we'll show you how to get started with Routines here so that you can start to automate your home. To get started, open the Alexa app, tap the menu icon (top left) and then select Routines.

## 1. Create a new Routine

Tap the Plus icon to create a new Routine, then tap the When this happens box. You get the choice of four options: Voice lets you enter the voice command that you want to use; Schedule lets you pick a specific time, including repeats on the days you choose; Device monitors when

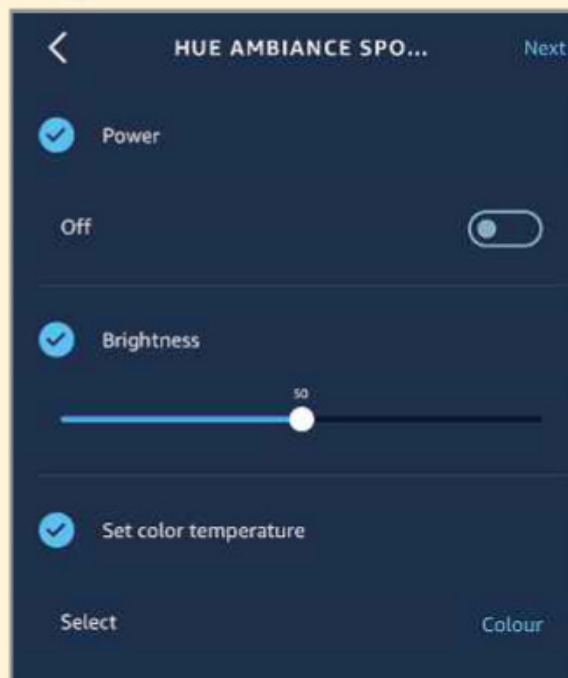


one of your smart devices does something, although we didn't have any supported options for this new feature; and Echo Button watches for the press of one of Amazon's buttons, which cost £20 for a pair.

We'll go with Voice, so select this and then enter the phrase that you want to use. Then tap Next.

## 2. Control a smart device

Tap Add action to add what you want to happen. You'll see a big list of possibilities, but we're going to start with smart home control, so select Smart Home from the list. Next, you get the option to control a device, group or scene (scenes are special, predefined routines that are built into some smart devices, such as Hue lights, where you can save your bulb settings).



Select a group or device, and then use the options to choose what you want to do. Options vary depending on the device. For example, with a Hue bulb, you can turn it on or off, or set the brightness and colour; a smart thermostat may only give you the option to set the temperature. Tap Next when you're done, then repeat this step to add more device control.

## 3. Get Alexa to do other things

Routines don't have to be about controlling smart devices; you can also use Routines to make Alexa do other things. When creating your Routine, tap Add action, then you can



select the other options. For example, you can have Alexa read out your calendar, report on the traffic (based on the settings in the app that you've entered, such as your work address) or read out the latest news and weather bulletins.

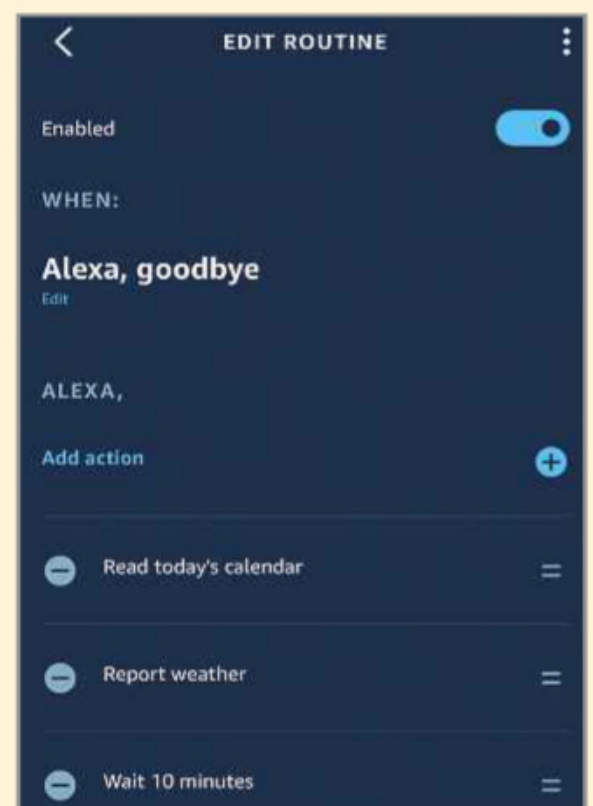
With these options, you could have Alexa tell you about the weather and what's in your calendar, before turning off all your lights and smart plugs as you head out. If you'd like a delay, you can use the Wait Action to add a pause in minutes or hours: a 10-minute wait between a weather report and turning the lights off should do it.

Tap Save when you're done.

## 4. Manage your Routines

You can now run your Routine using the trigger that you set, such as pressing a button or saying the wake word. Alternatively, if you have a time-based Routine, you can use the Alexa app. Go to the Routines part of the app and tap the Play button next to your routine.

To manage Routines, tap the name of your Routine. You can toggle the Routine on or off if you want to temporarily disable it. You can add new actions or delete and reorganise the list of current actions. Tap the three dots (top right) and select Delete Routine to get rid of one you don't want to use any more.



group. That makes control of devices so much easier, as you no longer need to remember whether you called it living room or lounge, bedroom two or kids' bedroom.

If you want to control devices in another room, you can still use the old way of speaking, such as saying to your kitchen Echo, 'Alexa, turn on dining room lights'.

To create a Group, go to the Alexa app and tap Devices, then tap the plus icon and select Add Group. Give your Group a name (there's a list of common rooms that you can select from to make life easier). Now, select the Echo device that's in the room (if there is one) and the smart devices that are in that Room and tap Save.

Now, on the Devices screen, you'll see your Group. If you've got lights in it, you can use the light bulb icon to toggle the lights on and off. Tap the Group to view the list of devices that are in it, and you can select each device for control or tap the Edit button to add or remove devices from your list.



# MUSIC AND COMMUNICATION

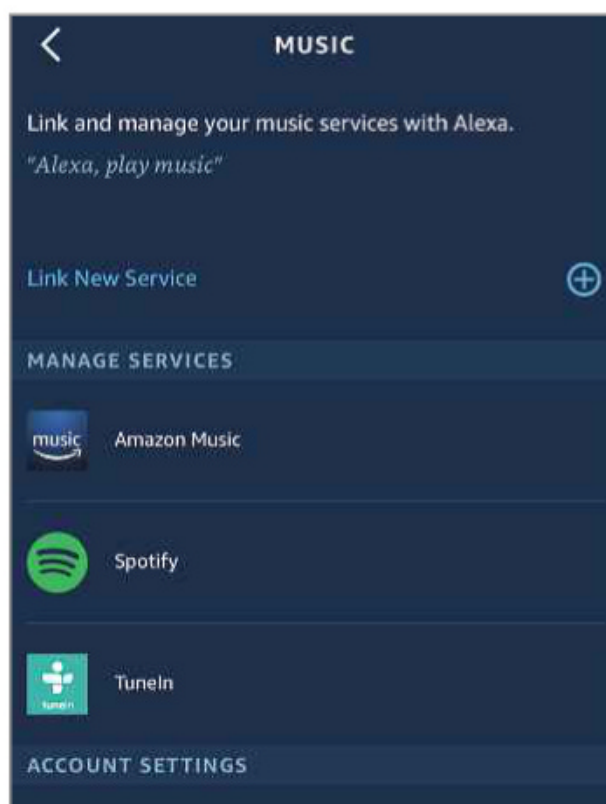
Alexa can control your music, even giving you multiroom audio if you want it, as well as acting as a free internet telephone service

**A**mazon Echo devices are about more than just giving you information, and can be used to play music, make calls and more. Here, we'll show you how to do more with your Echo devices and get them set up for music and communication.

Music is a good place to start, with Echo devices supporting a range of music services. To add the ones that you have, go to the Alexa app, tap the Menu icon and select Settings. Tap Music. You can then tap the Plus button to add a new music service, including Amazon Music, Spotify, Tidal and Apple Music. You also get TuneIn radio by default. When you add a new service, you'll be prompted to enter your username and password to log in.

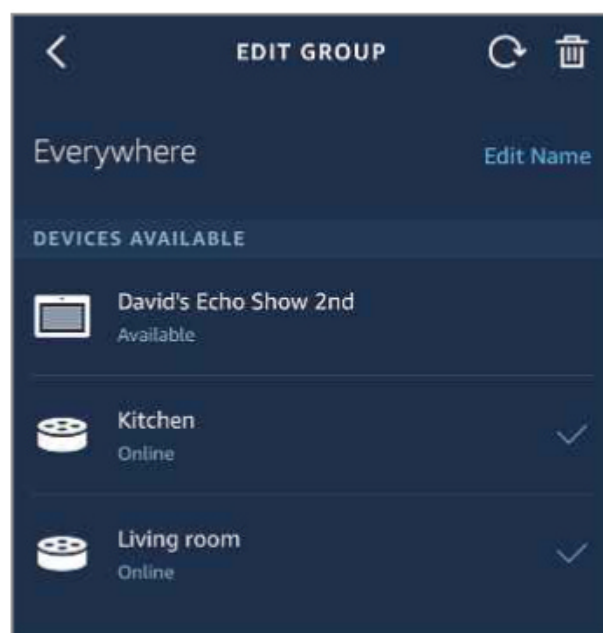
Once you're connected, you can tap the Default Services option to choose which music service you want your Echo to talk to first. Then, when you say something like, 'Alexa, play Pink Floyd', your Echo will search your default music service. To play music from a different service, you have to name it like this: 'Alexa, play Pink Floyd from Amazon Music.'

You can also start music from the Spotify app if you have a subscription, and then use the Cast button to select which speaker you want the music to play on.



## GROUPIES

If you want to play music in more than one group, you can do this via the app. Go to the Alexa app and select Devices, then tap the plus icon and select Add Multi-Room Music Speakers. Read the information, then tap Continue and give your Group a name. Tap Next, then select the Echo devices that you want to use, then tap Save. Amazon will then connect your Echo devices together.



You can now play music by mentioning the group: 'Alexa, play Pink Floyd <group name>'. To edit music groups, go to the bottom of the Devices page in the Alexa app. Tap one and you can add and remove Echo speakers, edit the name or remove it.

## DEATH BY STEREO

Stereo pairing is a feature that lets you use two Echo devices together, with one forming the left channel and one the right channel. The combination gives you more powerful audio and better stereo separation. To get a stereo pair, you need two of the same Echo devices of the right type: Echo Dot 3rd Generation, Echo 2nd Generation, Echo Plus (1st and 2nd Generation). Two Echo Plus devices work best.

Tap Devices in the Echo app, then tap the plus icon and select Add Stereo Pair / Subwoofer. Select two of the same type of Echo devices from your list, then tap Next. You're now given a choice for the first device you selected as to whether you want this for the left or right channel. As Alexa doesn't



play a sound through the speakers, it can be hard to work out which device is which; don't worry, you can change your choice later.

Once Alexa has paired the devices, you can see the stereo pair listed under Speaker Groups in the Devices section of the Alexa app. Tap the setting and you can switch the channel selection for the Echo devices.

Now, when you play music, sound will come out of both Echo speakers. Note that Alexa only plays sound out of one speaker if you ask a question.

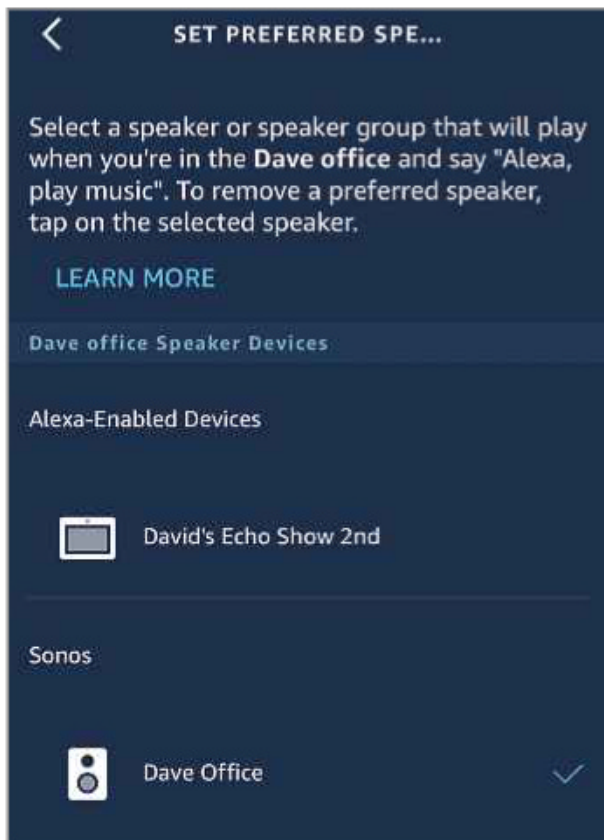
You can also add an Echo Sub for better bass, either to a standalone speaker (the speakers supported are: Echo 1st and 2nd Generation, Echo Dot 3rd Generation, Echo Plus 1st and 2nd Generation, Echo Show 1st and 2nd Generation) or a stereo pair. The Sub works best with the Echo Show or an Echo Plus stereo pair.

To add a Sub, go to Devices, tap the plus icon and select the Add Stereo Pair / Subwoofer, then follow the onscreen instructions to add an Echo Sub. Note that a Sub only works when playing music, not for video content on an Echo Show.

## GO WITH SONOS

If you have a Sonos system, you can integrate Alexa into that. First, make sure you've added the Sonos Skill so that Alexa can find your speakers. Now, you can start by saying something like, 'Alexa, play Pink Floyd on kitchen Sonos'. You can play, pause and adjust the volume in a similar way, but you might notice two problems.





First, it's all a bit of a mouthful, and Alexa will often get confused and play music on the Echo that you're using rather than the Sonos player. Second, there's the issue of ducking. When you talk to Alexa, the Sonos Skill is used to duck the volume on Sonos speakers, so there's more chance that your command will be heard. It's a great idea, but by default, Alexa will duck the volume on all Sonos speakers. So if you're using the kitchen Echo, the person listening to Sonos in their bedroom will keep having the volume go up and down.

The solution to the ducking issue is to put your Sonos speakers into groups with your Echo devices, following the advice on page 85. Now, when you talk to your Echo, the sound will only be ducked on the Sonos speakers in the same room.

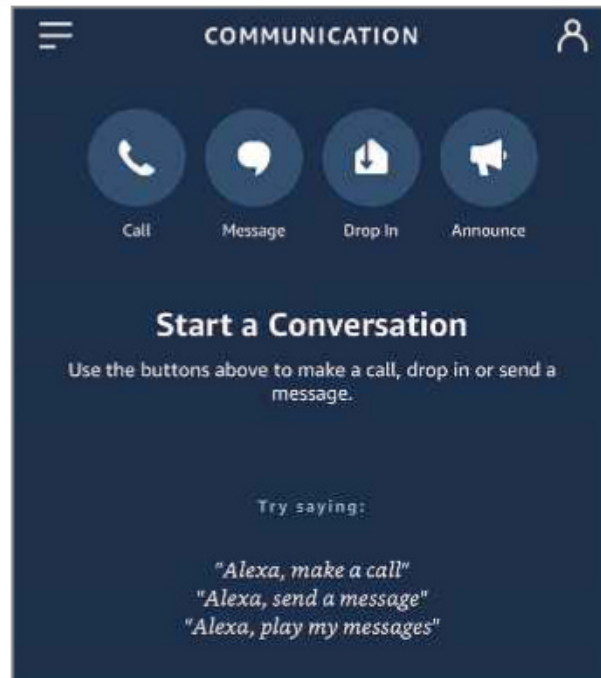
For the other issue, you can set a default music player in the Alexa app per group. Tap Devices, then select the group that you want. Scroll down and then select Preferred Speaker, and you can then select your Sonos player from the list.

Now, you can just say to the Echo in one room, 'Alexa, play Pink Floyd' and it will play through the chosen Sonos speaker.

## IT'S GOOD TO TALK

As well as playing music and controlling Sonos, your Amazon Echo devices are a good way to communicate either internally or externally. We'll show you how to get everything set up. First, you'll want to fill in your contacts list from your phone, so that Alexa knows who she can call.

To do this, open the Alexa app and tap Communicate. Tap Import and let Alexa access your contacts. Tap the Person icon at the top of the list to view your contacts. If you select a contact, you can add an Alexa nickname to make calling them easier.



## DROP IN

Drop In is a tool that automatically connects you to an Echo, starting a conversation immediately. For security, the Echo device you connect to will beep, so it's clear that someone is dropping in.

To activate Drop In, just say, 'Alexa, Drop In on <name of device or name of person>'. Inside your home, for example, you might say, 'Alexa, Drop In on kitchen'. To Drop In on an external device, you can say the name of the person that you want to talk to, such as, 'Alexa, Drop In on Mum'.

That might sound like a massive security risk, but the default settings only allow devices in your household and permitted contacts to Drop In. And, by default, no contacts are permitted. To permit a contact, go to Communicate, select the list of contacts, then choose the contact that you want and select Allow Drop In. If you don't see the option, then either you don't have the right telephone number recorded for that person, or they haven't yet imported their contacts list to allow for calls.

Why, you might ask, would you want to allow Drop In for other people? One reason is for setting up an elderly person's Echo. That way, if you can't reach them, you can Drop In and call out to them.



## YOU CAN CALL ME AL

You can also make calls using Alexa. You can say, 'Alexa, call <Echo name>' for local calls on your network, or 'Alexa, call <contact>' for external calls. Provided that your contact has associated their number with the Echo devices, your call will come to their house and their Echo devices will ring and Alexa will say, 'Call from <your name>'. Voice calls are made to standard Echo devices, but you can make video calls using the Echo Show or the Alexa app on your phone.

Similarly, you can send Messages to a contact. Their Echo will light up to let them know there's a message for them.

## I HAVE AN ANNOUNCEMENT

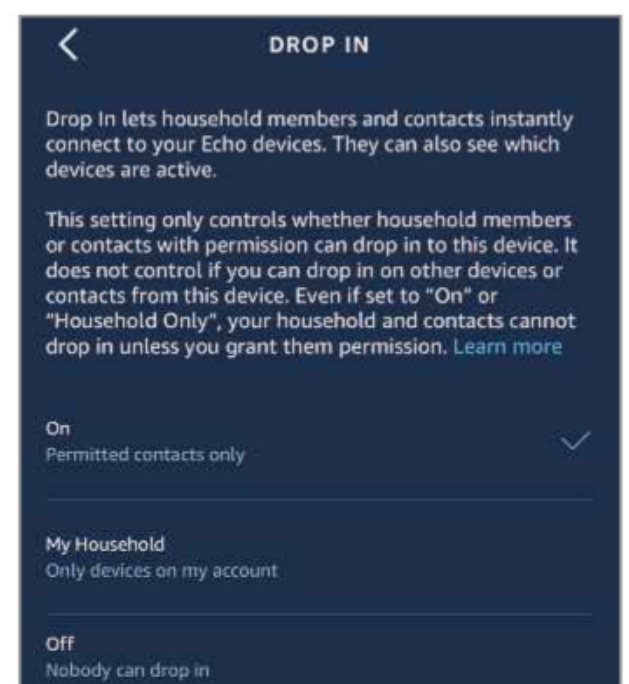
Announcements are a way of broadcasting a message to all your Echo devices – for example, telling everyone that dinner is ready. You can make an announcement from your Echo device by saying, 'Alexa, announce <your message>'. Your voice is then sent to all your Echo devices.

You can also use the Alexa app. Tap Communication and then Announce. You can type a message to be read back in Alexa's voice on your Echo devices, or you can record a voice message.

## TAKE BACK CONTROL

Communication settings are managed on a per-device setting. Go to the Alexa app, Devices, Echo & Alexa, then select the Echo device you want to control, then tap Communication.

If you want to turn everything off, just toggle the Communication switch. You also have more granular control over Drop In and Announcements. To manage Drop In, tap the option and then choose the level you want (Permitted contacts, My Household or Off). To manage Announcements, tap the option, then toggle the option on or off. Repeat for all the Echo devices that you have set up around your home or office to get the setting right for you.







# SPEAK HIGHLY

## Alexa speakers

Now that you know how to get the most out of an Alexa-enabled smart speaker, it's time to decide which model will best suit your needs

**THERE'S NO SHORTAGE** of Amazon Echo devices to choose from, and that's not even counting all the third-party speakers with Alexa integration. To pick apart this selection, we've tested all current-gen models in the Echo range, as well as the Sonos One, one of the best Alexa speakers not made by Amazon.

There's a remarkable amount of variation here, but for basic 'smart' use there's not a lot of difference as they all use Alexa. Only the Sonos One is missing support for a few of Alexa's more specialised features, and the only

other key difference is how the Echo Plus and Echo Show both have built-in smart hubs.

The more significant differences therefore come by way of design, audio quality and price, so this buying guide will focus on these.

### LOCATION, LOCATION, LOCATION

Keep in mind where your speaker will sit. For those with a display, you'll need to have them on a lower surface for easy reading and touch control access. Indeed, the Echo Spot is designed specifically for placement on a bedside table or desk, while the Echo Show feels most at home on a kitchen countertop.

For screen-less speakers, it's fine to keep them on a higher shelf, but you'll want them in a position that won't muffle the sound, and ideally distributes it evenly around the room.

While far-field microphones mean you don't have to shout right into an Echo device for Alexa to hear you, a more central position might help it pick up commands from wherever you are in the room. Some Echo devices have four microphones, but those with seven or eight can be better at picking up speech over long distances and with potential disruptions (such as music) within earshot.

Generational hardware upgrades have meant that most of the Echo range, even the diminutive Echo Dot, can function as

reasonable music speakers; only the Echo Spot falls flat in this regard. That said, they're no hi-fi rivals either, and even the standard Echo model can benefit from using its 3.5mm output to connect to a better audio system.

The best Echo products, in sound fidelity terms, are the Echo Plus and the Echo Show, despite the latter only having a single driver. These serve a lot better at high volumes than their stablemates, although if sound quality is your absolute priority, it's worth looking at the Sonos One instead. This trades off some of the Echo family's smart home prowess in exchange for the playback quality and multiroom functionality you'd sooner expect from an audio-focused brand like Sonos.

The downside is that the Sonos One is relatively expensive, whereas the affordability of Amazon's own line-up is one of its strong suits. Even the 2nd-gen Echo Plus is no more expensive than the original Echo speaker.

However, remember that smart speakers work best in a network, which means buying multiple devices to spread throughout your house. If you take this route, you don't have to waste cash on multiple Echo or Echo Plus units: the comparatively cheap Echo Dot and Echo Input are ideal for extending the range with which you can make voice commands and control your smart home kit.

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**SONOS** One



# AMAZON Echo 2nd Generation



£90 • From [www.amazon.co.uk](http://www.amazon.co.uk)

## VERDICT

Even if it's not the best-sounding smart speaker, the Echo 2nd Generation is a versatile and well-priced update

**HOW DO YOU** follow up a device like the Echo, which almost single-handedly took voice assistant speakers into the mainstream? Amazon's answer is to make a brand new Echo that's smaller, lighter and considerably cheaper than the original. At £90, when the original cost £150, the Echo 2nd Generation seems like a fantastic deal.

Stand the new Echo next to the old one and you can see that it's about two-thirds the height – 89mm shorter, to be more specific – although it's still roughly the same diameter. This makes placing the new Echo that little bit easier, as it will fit on to most shelves with ease. The fabric finish also looks better than the original's plain plastic, and helps the Echo blend into its surroundings much more successfully than before. If you spend an extra £10, you can get the even fancier oak, walnut or metallic casings instead.

## TURN AWAY

To get the price down, however, Amazon has had to cut some features. Most noticeably, the rotating volume dial at the top has gone, replaced with physical buttons seemingly borrowed from the Echo Dot. That's a bearable change, and the separate wake and mute buttons are still included, but the old dial felt more premium and was nicer to use. The replacement buttons, on the other hand, are functional but thoroughly basic.

Conversely, Amazon has upgraded the internals, fitting a Dolby-powered speaker system with a 0.6in tweeter and 2.5in woofer. This should theoretically make it a better music speaker than the original Echo, although some issues remain: it distorts at high volumes and bass isn't as pronounced as it could be, despite Amazon launching a firmware upgrade to boost low-level sound. The 2nd Generation model is good for mid-level listening and well suited to a smaller room or kitchen, but the more expensive Echo Plus and Sonos One both comfortably beat it on sound quality.

Amazon has also added a 3.5mm headphone jack output next to the power input, so as with the Echo Dot you can plug in an external speaker to improve audio output. However, this is a considerable amount of added effort and expense, regardless of the price drop from the original Echo.

Why bother with this model, then? For one, audio fidelity isn't everything on a smart speaker (although the Echo 2nd Generation does outdo the small Echo Spot in this regard), and compared to the competition, £90 is a pretty low price.

## HOUSE PARTY

There's no particular benefit from using Alexa on one of Amazon's own devices, but it's still a good assistant, especially – compared to Siri and Google Home – for smart home integration. This is thanks to Alexa's expandable range of Skills, which let the smart assistant do pretty much anything you want, from turning lights and heating on or off to controlling security cameras.

This depth of integration also works brilliantly with Alexa routines, which can be set to perform multiple actions in response to a single phrase. For instance, just say 'Alexa, good night' and the Echo can switch off the lights, lock the door and turn off the TV. The potential for sheer convenience is huge, and is a very strong argument in favour of the Echo valuing smart features over sound quality.

And that's just in the smart home department; Alexa is just as adept at reading a bedtime story or delivering train service status updates. Google Home tends to be a bit smarter when answering queries, and is better at accurately interpreting speech commands, but Alexa's flexibility gives it an edge.

This is especially true now that Amazon has continued to refine and add features to its

digital assistant. One of the best is Drop In, which allows you to group together commands and make calls between Echo devices and apps. It's particularly useful for family homes, whether you want to summon the kids downstairs to have dinner or make a call to the kitchen on your way home from work. Call quality is superbly clear, too.

## BACK FOR SECONDS

As a pure music speaker, the Echo isn't quite up there with the best, or even particularly close. Compared to the original Echo, let alone the Echo Plus or the Alexa-powered Sonos One, the mids are slightly thinner and harsher-sounding. In fairness, it's such a small difference that you'll only notice the difference if you're switching between the two devices with both stood next to each other, as we did when testing. Still, if you want a smart speaker that emphasises the speaker aspect, you'll have to spend more elsewhere.

However, the Echo 2nd Generation fills a mid-range gap in the Echo line, which has expanded significantly since the original Echo launch, and makes a fine choice if you want a clear-sounding smart assistant that you don't strictly have to plug into an external hi-fi to occasionally play some music.





## AMAZON Echo Dot 3rd Generation



£50 • From [www.amazon.co.uk](http://www.amazon.co.uk)

### VERDICT

**Better, louder audio with the same great design – the latest version of Amazon's dinky speaker is another winner**

**AMAZON HAS LONG** been cheerfully ignoring the old maxim of 'if it ain't broke, don't fix it'. The original Kindle still works perfectly well, but Amazon has honed the e-reader format into both the first and last words in the industry. And that's what it's doing now with the compact smart speaker, one device at a time.

Equally, the Echo Dot didn't really need fixing, but Amazon did it anyway – twice now, in fact. This is the only Echo device to be on its third iteration, and the newest Echo Dot is a masterclass in making everything better without a price hike.

The Echo Dot costs £50 – the same as its predecessor – and that means that in terms of competition, there's only one game in town: the Google Home Mini. This, however, lacks an audio output jack, unlike the Echo Dot, which has a 3.5mm auxiliary output. As a result, it's in the peculiar position of being both Amazon's entry-level smart speaker and a device that can connect to any other sound system, whether it costs £100 or £10,000.

### SMALL TIME

The original Echo Dot looked like someone had sawn off the top bit of the original Echo, but Amazon has thankfully refined the design over the 2nd and 3rd generations (which are outwardly identical). It's still a puck, but it's a bigger puck: both taller and wider, with dimensions of 99x99x43mm, compared to the previous generation's 84x84x32mm. It's also nearly twice as heavy, coming in at a chunky 300g to the original's 163g.



But added heft isn't the only change: gone is the cheap-looking plastic casing of the original, replaced with curved fabric around the outside. The top is still plastic, but it's curved, and feels almost rubbery to the touch. It's also lost the ostentatious Amazon logo, which helps too.

The big change is on the inside: gone is the 2nd-gen Echo Dot's 1.1in speaker, replaced by a 1.6in speaker that fires sound in 360°. It maintains the four buttons on top – volume up, volume down, a button to trigger Alexa, and a button to mute the mic for privacy – as well as the blue ring that lights up when it hears the wake word. Flip it around, and you'll

goes an awful lot louder than the previous generation, although you won't want to push this too far: it's still just a 1.6in speaker, not a club-grade sound system.

That's not to overstate the quality, because it's likely that any dedicated sound system you own will be better than the latest Echo Dot's output, and you should make pairing it with another system a priority if you have one. It's also not remotely as capable a music device as the Echo Plus; it's not as if Amazon has undercut itself. Regardless, it's a major improvement on previous Echo Dots, which sounded more akin to a radio alarm clock than a speaker.

## The newest Echo Dot is a masterclass in making everything better without a price hike

still find an area cut out for an audio connector and the power source (the Echo Dot uses the same kind of power connector you get with the larger Echo devices).

In other words, the Echo Dot looks appreciably slick, but it's the internal speaker upgrade that's most exciting here. You could use the original Echo Dot as a standalone speaker, but that wasn't Amazon's intent. The 0.6in tweeter inside was only really good for voice, with a reedy output just about sufficient for audiobooks and podcasts. That was fine: it was designed to be connected to other speakers, either via Bluetooth or audio cable. The second-generation model moved more towards standalone sound with its much larger speaker, but still struggled with volume and clarity.

### EASY LISTENING

The good news is that the third and latest Echo Dot makes a solid little speaker in its own right, thanks to that 1.6in speaker packed within. The reedy, prone-to-distortion audio of the original is gone completely, and the overall sound feels more bassy, warm and generally richer. It also

The Echo Dot 3rd Generation provides sound that's definitely listenable, and on a par with an average £30–£40 Bluetooth speaker. It's more than adequate for a small room where you just want to have Alexa on tap without needing to splash out.

### DOT MATRIX

One thing that hasn't changed from older Echo Dots is that if you're after smart speaker functionality rather than audio quality, the new model is just as much a bargain, as it essentially has all the Alexa features of its more expensive brethren. It's also perfect for buying in multiples and spreading them throughout your home to create a network of voice-activated smart home controllers.

This means that if you already own a Dot or two, there's not much reason to upgrade; you might as well just buy a better-sounding speaker. If, however, you haven't already tried a smart speaker, then this is your best entry-level bet. Previous Echo Dots were also the wisest choice for dipping a toe in the world of smart speakers, thanks to Google cheaping out on an audio port on the Home Mini, but now it's even better and costs no more than before.





# AMAZON Echo Input



£35 • From [www.amazon.co.uk](http://www.amazon.co.uk)

## VERDICT

**It's not a speaker itself, but the Echo Input can quickly and cheaply turn most old speakers into smart Alexa devices**

**THE ECHO INPUT** is the odd one out of Amazon's smart speaker range, and that's because it's not really a smart speaker at all. Instead, it's something loosely akin to the Chromecast Audio: a disc-shaped connector that turns older, 'dumb' speakers into modern smart devices. This goes even further than Google's discontinued dongle, however, adding not just music streaming but full Alexa assistant capabilities as well.

In this sense, it's more like the Echo Dot but without the speaker. That's something you'll have to supply yourself, but as long as the Echo Input can connect either via its 3.5mm cable or over Bluetooth, it's likely to work; Sonos speakers aren't currently supported, however.

After you've done this, the Input behaves like every other Amazon Echo product, allowing you to ask questions about the weather, sports results and trivia, control smart home devices, stream music and set timers, all with the power of your voice. Despite the low price, there's nothing the full-fat Echo or Echo Plus does with Alexa that the Echo Input can't.

## FOUR SCORE

As such, the Echo Input is the cheapest way of getting in on the Alexa smart speaker scene. At £35, it's £15 cheaper than the Echo Dot, the most affordable Echo speaker that actually has a speaker; the latter could therefore be considered better value if you don't already have a speaker to partner the Echo Input, but if you do, this will get smart functionality into your home for the lowest initial outlay.

The top of the Echo Input also looks a lot like the Echo Dot; the layout is precisely the same, with activation and microphone buttons flanking a central status LED. The four microphones are arranged on the top surface in a square, forming a noise-cancelling, beamforming array which is able to pick out your voice from across a room, even above moderately loud music.

On the edge is a 3.5mm audio output jack and a Micro USB port for power. Unlike the Chromecast Audio, there's no optical output, which will likely disappoint anyone hoping to use the Input as a source for a more exotic, high-end system.

Setup is a breeze. Just as with an Echo Dot, you plug it in, wait for the central LED to turn orange and then use the Alexa app on your smartphone or tablet to add a new product,



following the instructions onscreen to complete the installation.

Performance is pretty good, too. We connected it directly to a set of active stereo studio monitor speakers, placing the Input on top of the right speaker, and found the microphone array impressively sensitive. Even against a background of moderately

disappointment here is that there's no support for the more advanced Bluetooth codecs, such as aptX, aptX HD and LDAC.

In some ways, however, these concerns don't really matter. The Echo Input has been designed as a cheap way of adding voice control to an existing speaker, nothing more, nothing less. You can't expect it to act as a

## You could potentially end up with sound quality that can stand up to the Echo Plus or Sonos One

loud music being played out of the speakers, it was able to pick up instructions and questions without us having to raise our voices too loud or repeat ourselves.

Achieving stable Bluetooth connectivity to an existing Bluetooth speaker works well, and the Input will helpfully send you a notification via the smartphone app whenever it becomes disconnected from its partner device.

## MIXED SIGNALS

Unsurprisingly, sound quality is nowhere near premium dedicated DACs such as the iFi Nano and Chord Mojo. There's such a marked difference in depth, clarity and instrument separation that using the Echo Input with a pair of big, expensive speakers over the 3.5mm connection almost feels like a waste of the speakers.

It's better via Bluetooth, where the Echo Input's own DAC and circuitry won't have such a big effect. And this is where it's best employed: reviving a high-quality, but dumb, Bluetooth speaker that may be gathering dust somewhere at home. For £15 less than the Echo Dot, you could potentially end up with sound quality that doesn't just surpass the tiny Echo Dot but can stand up to the Echo Plus or Sonos One, coupling top sound quality with all the smarts of Amazon's digital voice assistant. The one

source in an expensive audio setup, and it's only because the Chromecast Audio had a digital optical output that it's even worth making comparisons.

## DISC ASSESSMENT

The fact remains that the Echo Input does its core job very well indeed – as specific and even niche as that job is. It's only £35 and works about as perfectly as you could want for such little money, allowing you to give old Bluetooth and analogue speakers a timely smart boost. If you have an old speaker sitting around that you just can't bear to part with, the Echo Input is definitely worth considering.





# AMAZON Echo Plus 2nd Generation



£140 • From [www.amazon.co.uk](http://www.amazon.co.uk)

## VERDICT

With an integrated ZigBee hub and improved sound quality, the latest Echo Plus is a winner

**LIKE THE ORIGINAL** Echo Plus, this updated model wants to be all things to all Echo owners. An integrated ZigBee smart hub can put it even closer to the centre of your smart home setup than cheaper Echo speakers, and sound quality is prioritised, too.

This time, there's also a built-in thermometer to tell the temperature of the room it's in, which should make smart thermostat features all the more effective. Even with its remarkably similar physical design, it's even clearer than before that the Echo Plus isn't just an Echo with nicer-sounding tweeters; it's a fully distinct device with its own standout features.

## LOW INFLATION

It's worth reflecting on the journey Amazon has come on pricing in just a few short years. The original Echo would set you back £150, before the second-generation model slashed that fee to £90. The Echo Plus, aimed at smart homeowners after better audio quality, still managed to undercut the original Echo, coming in at £140. This new version, impressively, maintains that enticing price.

While the previous Echo Plus kept the tall cylindrical design of the original Echo, the metallic look is officially gone from Amazon's closet with this new model. The new Echo Plus copies the look of the Echo 2nd Generation but with its very own softer spin: it's dumpier and fabric covered, intended to stand out less obviously in the home.

It's generally an improvement, but the change comes with the same disappointing casualty as the main Echo: you can't twist the top of the speaker to adjust the volume.

The big circular status LED is still there, but the physical buttons on top are the only way to alter the volume without raising your voice, which is a pity.

In fact, put the Echo and the Echo Plus side by side and you might struggle to tell the difference. The Echo Plus is slightly fatter – 11mm fatter, to be exact – and it has rounded edges at the top instead of sharp ones, but that's it.

There's still a line-out connection on the back, so you can output the audio from the Echo Plus to another speaker. This time, however, you can switch to line-in, meaning you can play music directly from another source.

Regarding audio quality, you get a boost from the new Echo Plus: while you're looking at (or listening to) the same 0.8in tweeter from the previous generation model, the woofer has bulked up from 2.5in to 3in. Therefore, the higher frequencies will sound the same, but the bass notes should sound deeper and richer.

In practice, that's exactly what the Echo Plus 2nd Generation achieves. Compared to the standard Echo, the sound quality is immediately markedly better, with rich, warm notes and decent bass replacing the somewhat harsh and thin output that the Echo is prone to delivering.

## GRACE AND NOISE

It's loud, too – almost unfeasibly so for a speaker this size – but bear in mind that it distorts if you turn it up too high, and the higher-frequency notes tend to eclipse the bass when pushed. This is a speaker for listening to at quiet to medium levels; it's not much of a party speaker.

We also wouldn't say it sounds as good, in general, as the Sonos One. Still, it's a fair bit cheaper, and is a much better standalone speaker than most other Echo speakers. The latest Echo Show, of all things, comes close but doesn't control its bass quite as well.

Thanks to its ZigBee hub, the Echo Plus can also talk directly to many smart home devices – from Philips Hue bulbs to your Hive Thermostat – without needing any additional hubs. This isn't

quite so useful now that smart home manufacturers are adding Alexa voice controls to their products themselves, but it's still likely to save on faff.

The Echo Plus's built-in thermometer adds another dimension to this, and allows for automated actions based on room temperatures. Alexa can judge when a room is getting too hot and automatically turn on a smart fan; likewise, if it's too cold, Alexa can turn on a heater.

As before, however, it's best that you make the Echo Plus your first step in making a smart home. If you already have a smorgasbord of compatible devices, you'll have to reset all of them to pairing mode before Alexa will acknowledge them. You only have to do this once, of course, but it's still a bit of a pain.

## JOIN THE HUB

Once again, Amazon has offered steady, solid improvements with the Echo Plus. Sound quality, styling and features are all on the up.

It's therefore a worthy purchase, although unlike the original Echo Plus when it launched, it's not your only choice of Echo product if you want both extensive smart home control and high-quality music playback. The Echo Show also contains a ZigBee hub, and because it has a screen, using it to control smart home equipment can be even more intuitive.

It's not outright better than the Echo Plus, as sound quality, though high, isn't quite a match, and it's more expensive, too. Still, you should look at both before making a choice.





# AMAZON Echo Show 2nd Generation



£220 • From [www.amazon.co.uk](http://www.amazon.co.uk)

## VERDICT

**Bigger screen, bigger sound, better microphones: the second-gen Echo Show is a much improved smart home controller**

**AT THE TIME** of its release, the original Echo Show was easily the most technically able of Amazon's Echo family, so it's good to see the design refined for a 2nd-gen model. It's timely, too: with the launch of the Google Home Hub, Lenovo Smart Display and JBL Link View, the upgraded Echo Show has the chance to prove it's the best of these smart displays.

One wise change Amazon has made is moving the speaker from the front to the rear. This allows for a larger screen in a shorter package, which is absolutely worth the slightly bigger footprint. It hasn't entirely shed its gawkiness, however: since the top bezel is broader than the other three (it contains the 5-megapixel camera and several microphones), the Echo Show still has a lopsided look that's somewhat out of kilter with its ultra-modern smart home ambitions.

Four additional microphones sit on top of the speaker, as do the mute and volume buttons. A cutout in the rear of the speaker also contains the DC power input – like the rest of Amazon's Echo speakers, the Echo Show is a mains-only speaker and has no battery – and a Micro USB port, but no 3.5mm input or output.

## THE PANELS OF HISTORY

A more significant upgrade is the display itself. It's streets ahead of the previous Echo Show, with much more contrast and punchier colours, and even the touchscreen surface feels smoother and more pleasant. In fact, the whole unit simply feels higher quality, right down to the fabric-covered speaker.

It also sounds a lot better than the first Echo Show, being bassier, fuller sounding and potentially much louder. It's no match for a more specifically audio-focused smart speaker such as the Sonos One, nor is it as refined as the Echo Plus, as the bass is slightly too overbearing on default settings and cranking up the volume can result in distortion. Nonetheless, it's a big improvement, and after some tinkering with the EQ settings we'd happily use the Echo Show as a standalone speaker.

It's also worth pointing out that the improved microphone array really does work well. The 2nd-gen Echo Show is far more sensitive to the Alexa wake word than the original version: whereas we frequently had to repeat ourselves with the old Echo Show, the new model is much better at picking up speech.



The Echo Show also has a slightly tweaked user interface and a number of new features. The first is greater smart home control: drag a finger down from the top of the touchscreen, tap the Lights & More option and you'll see a scrollable list of all your smart home gear – from lights to cameras – with toggle switches alongside.

This addresses an issue we've often had with smart speakers: the need to remember the name of every single connected device in order to voice-control them. Unlike on the Home Hub, you can also browse the web via either Firefox or the Amazon Silk browser, which gives you access to YouTube, among other streaming video services.

## SING ALONG

Largely, what the screen on the Echo Show can display is much the same as before: it can show lyrics to songs played from Amazon Music; it can stream TVs and movies directly from Amazon Prime Video or YouTube; it can patch you through to the live feed from connected security cameras; and it can show visuals to go with things such as your current timers or weather and sports results.

There's plenty you might expect it to do that it can't, however. You can't watch Netflix, for instance, and there are plenty of irritations with third-party apps. Ask the Echo Show to play BBC radio stations, for instance, or anything from the default TuneIn internet radio service, and the onscreen experience leaves a lot to be desired. All you get is some text telling you the current show and station, a rather low-res radio station icon on a vast swathe of plain background and some Alexa tips at the bottom of the screen.

Frankly, this is a wasted opportunity, and a failure to make the most of the screen – the Echo Show's defining feature. There's not even a permanent spot for showing the time; you need to tell Alexa to go to the home screen for that.

Still, approach this as a more feature-rich Echo speaker with video calling and playback features and you won't be too disappointed. After all, it works much like any other Echo has done before it, with all the pros and cons that come with using Alexa as your digital assistant rather than Google Assistant. In short, Google Assistant is better at answering questions than Alexa, and it's better at understanding what you're asking it as well. Conversely, Alexa is better at the basics. Through its Skills, it's directly compatible with many more items of smart home hardware.

## MUST GO ON

When it comes to smart displays in general, the Google Home Hub is better at responding to queries, and the JBL Link View sounds better, so the Echo Show only really has its display and smart home hub to help it stay relevant. Compared to the rest of the Echo range, however, it's once again the most sophisticated device of the lot. The screen is particularly helpful for smart home usage, a valuable quality when the Echo Plus just pips it on sound quality.





## AMAZON Echo Spot



£120 • From [www.amazon.co.uk](http://www.amazon.co.uk)

### VERDICT

**This smart alarm clock is a decent, cheaper alternative to the Echo Show**

**AMAZON DESCRIBES THE** Echo Spot as a 'smart alarm clock', but there's a lot more to this little device than that would imply. It may look like something designed to get you out of bed, but with full Alexa integration and a colour display – if a much smaller one than that of the Echo Show – it's one of the most interesting products in the entire Echo family.

The main appeal of the Echo Spot compared to the larger Echo Show – besides the lower price – is its size and the way it looks. It's spherical in shape and about the size of a grapefruit, with a portion of the bottom sliced off so you can stand it on a flat surface, while a section of the front has been cleaved away and replaced with a circular 2.5in, 480x480 resolution touchscreen and VGA camera.

It's the perfect size to use on your desk as a smart speakerphone-cum-intercom. You can use it, as Amazon suggests, as a voice-driven alarm clock, but you'll need to make sure you mute the microphone and camera when you go to bed to avoid your contacts dropping in on you at awkward moments. Fortunately, like the Echo Show, the Spot has a mute button to do just that, and there's also a Do Not Disturb mode to prevent intrusions while you sleep.

### A MATTER OF TIME

Otherwise, the Spot is ideally suited to the role of smart alarm clock. When you're not asking it questions or making video calls it displays a nice-looking clock face, with 17 different styles to choose from and, when you wake up, the display scrolls through news snippets about which you can ask Alexa for more details.

Naturally, you can use voice commands to set an alarm to wake you with a regular alarm tone or your choice of music or radio station. Beware, however: there's no way of telling if Alexa has completely figured out your request until the alarm actually goes off, so there's a chance of an early morning shock as she tries to wake you up with a blast of punk rock when all you wanted was the calming sound of waves lapping the shore.

Does the circular touchscreen add to the Alexa experience otherwise? Much like the Echo Show, it can display both useful information and trivia, and allows you to interact with all sorts of things with the power of your index finger. You can access all of your device settings such as display brightness, Wi-Fi and Bluetooth, as well as watch the occasional movie or TV show via Amazon Prime Video.

Likewise, you can make and receive video and audio calls, as well as view Amazon's

flash cards when you ask Alexa a question, or you can receive song lyrics whenever you play your favourite tunes.

### SPOT OF BOTHER

The Echo Spot works well with a long list of smart home devices, from smart bulbs to thermostats, and the screen means it's ideally suited to smart security cameras such as the Nest IQ cam, for which you can bring up the feed with a simple voice command.

Unfortunately, there's one crucial negative aspect: sound quality. Despite matching the Echo Show for features and smart speaker capabilities, the Echo Spot comes nowhere near it on the fidelity of its audio output.

It's perfectly fine for catching up on the news headlines or your favourite podcasts, but there's simply not enough bottom end or warmth to do your favourite music justice,

and it doesn't reach very high volumes, either. These shortcomings are particularly apparent now that the Echo Dot, which in its first iteration sounded even worse, is now a far more reasonable choice of speaker thanks to the 3rd generation model's enlarged tweeter.

With the Echo Spot set up in a moderately sized kitchen, we often found that even turning up the volume to its highest level wasn't enough to raise it above the background noise of the extractor fan or the kettle boiling. It's worth noting, however, that you can hook the Echo Spot up to an external speaker via the 3.5mm aux out or Bluetooth for a fuller, more engaging sound.

On a much brighter note, the Echo Spot employs the same excellent far-field microphone technology as its other Echo-powered siblings. There are four microphones here instead of the seven you get on the standard Echo and Echo Plus, and they're just as effective at picking up commands from both short and long distances, and against quite noisy backgrounds.

### BEDSIDE MANNER

The Echo Spot is one of the most distinctive Alexa-powered devices Amazon has released. It's far better equipped to blend into your home's decor than the Echo Show and Echo Input, and the circular touchscreen adds valuable extra features.

The low audio quality is a shame, especially since this is one awfully expensive alarm clock; at £120, it costs more than two Echo Dots, not to mention £30 more than the Echo 2nd Generation and only £20 less than the Echo Plus. Then again, it does have a display, and for a full £100 less than the Echo Show, so it could be viable if you'd prefer a smaller touchscreen.





# SONOS One



£169 • From [www.cramptonandmoore.co.uk](http://www.cramptonandmoore.co.uk)

## VERDICT

**Sonos and Alexa join forces in this great-sounding smart speaker**

**NO, THIS ISN'T** an Echo speaker; it won't even solely be an Alexa speaker, as an update enabling Google Assistant is planned for this July (although this feature is overdue an initially planned 2018 launch).

The Sonos One is, however, one of the best third-party Alexa speakers on the market, so is worth looking at here alongside Amazon's own wares. It's arguably closest to the Echo Plus, coming in with a premium price and a focus on audio quality, but there's no built-in smart hub or touchscreen display.

## ONE TO ONE

Design-wise, the Sonos One is extremely reminiscent of the Sonos Play:1 (*Shopper* 345). Both are neutral-looking, squat speakers with an Ethernet port on the rear (complementing the Wi-Fi); the only fundamental differences are the lack of a threader speaker mount, meaning the One can't be wall-mounted, and that the physical buttons of the Play:1 have been replaced by touch-sensitive controls.

The central button pauses or resumes playback, buttons either side adjust the volume, and another positioned above toggles the microphone on and off, with a small white LED signifying when the One is listening out for voice commands. The only other button is at the rear, and for good reason: it's only used at the beginning of the setup process, so you won't need to use it very often.

If you're familiar with the Play:1 speaker, you know what to expect from sound quality. The One might be small but its sound is the opposite: it's exciting, detailed and as capable of droning out soothing ambient as it is firing out staccato guitar riffs and vicious techno.

As you'd expect for such a tiny speaker, the bass isn't earth-shakingly powerful and there isn't the mighty mid-range slam of Sonos's larger speakers, but what's there is surprisingly potent and well controlled.

Crucially, the One's sound blends perfectly with the other speakers in the Play family, so if you incorporate it into a Sonos multiroom setup you don't get sudden changes in tonality as you wander from one room to another. Unfortunately, this leads to one minor complaint: Sonos doesn't officially allow you to pair a Sonos One with a Play:1 to form a stereo pair.

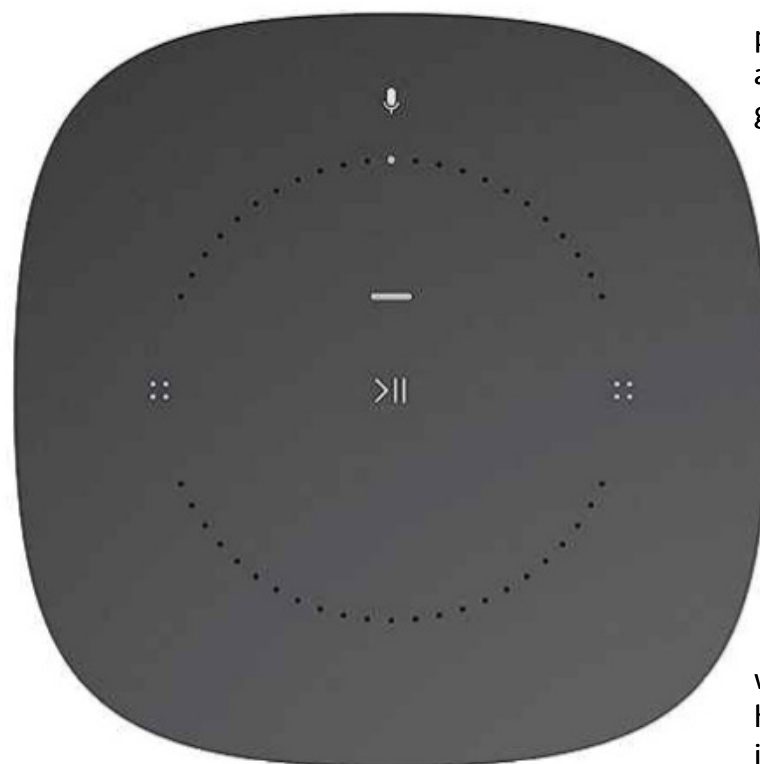
Given the near-identical sound profile of those two speakers, that's a bit of a shame. Thankfully, however, there is an unofficial solution: you can download the SongoSequencer app for iOS and link a Play:1 and One together.

Another limitation is that the Sonos One can't do everything Amazon's Alexa-powered Echo products can. You can ask general questions about the weather or nearby shops and services, perform maths and weight conversion calculations, set alarms and reminders, among many other things. However, you can't use any of the voice call, Drop In or messaging features, nor can you ask Alexa to read ebooks or receive notifications. You can't change the wake word, either.

## ONE FOR ALL

That all adds up to one good reason to keep it in the Echo family, but then none of those speakers slots into a multiroom system as the Sonos One does. Granted, the setup process is more convoluted than that of a pure Sonos speaker, clunkily bouncing you between the Alexa and Sonos apps on your phone, but that effort is worthwhile. Add it to an existing system, and you can then control playback across an entire home with voice commands. For instance, you can adjust the volume in specific zones, play music in different areas of the house, or pause playback and skip through tracks.

What it doesn't currently let you do, however, is group rooms together or actively move the music from one room to another.



One workaround is to group all the speakers in your home using the Sonos app, then ask Alexa to mute or unmute rooms as you see fit.

Alexa is also able to control playback from Spotify, TuneIn Radio and Amazon Music, but that isn't the case for Tidal, Apple Music, Bandcamp, SoundCloud or any of the other services supported by Sonos. While playing music from these services, it's only possible to pause playback or adjust the volume. Another thing to remember is that you'll need a Spotify Premium account if you want to take advantage of the integration.

## FINE TUNE

Use any of the supported services, however, and Alexa comes into its own. You can ask Alexa to play music by genre or artist, or request specific tracks, albums, playlists or radio stations.

If you're already used to pulling out your phone and choosing music from the Sonos app, voice control might seem more like a gimmick than a killer feature, but it soon becomes second nature.

The exception is when Alexa gets confused about what you're trying to play, which can happen from time to time. Often this is helped by spelling out the name of the band, album or song you want, but sometimes the only way to stop Alexa playing the wrong song with a similar title is to use the app.

Despite all the minor niggles and frustrations, the Sonos One can quickly and happily become an integral part of any Sonos system. It's distinct from the Echo range in that music takes centre stage, and while it therefore might not have the smart home chops of the Echo Plus or Echo Show, its sound quality surpasses both of them.



ALEXA SPEAKERS



Award	RECOMMENDED	BEST BUY		
Manufacturer	AMAZON	AMAZON	AMAZON	
Model	Echo 2nd Generation	Echo Dot 3rd Generation	Echo Input	
Rating	★★★★☆	★★★★★	★★★★☆	
HARDWARE				
Drivers	2	1	None	
RMS power output	Not stated	Not stated	N/A	
Microphones	7	4	4	
Audio inputs	None	None	None	
Audio outputs	3.5mm aux	3.5mm aux	3.5mm aux	
Dock connector	None	None	None	
Wireless	Wi-Fi, Bluetooth	Wi-Fi, Bluetooth	Wi-Fi, Bluetooth	
Ethernet	No	No	No	
NFC	No	No	No	
Screen size	N/A	N/A	N/A	
Screen resolution	N/A	N/A	N/A	
Camera	None	None	None	
Dimensions	148x88x88mm	44x99x99mm	14x80x80mm	
Weight	821g	300g	79g	
SOFTWARE				
Digital assistant	Amazon Alexa	Amazon Alexa	Amazon Alexa	
App support	Android, iOS, Fire OS	Android, iOS, Fire OS	Android, iOS, Fire OS	
BUYING INFORMATION				
Price	£90	£50	£35	
Warranty	One year RTB	One year RTB	One year RTB	
Supplier	www.amazon.co.uk	www.amazon.co.uk	www.amazon.co.uk	
Details	www.amazon.co.uk	www.amazon.co.uk	www.amazon.co.uk	
Part code	Echo 2nd Generation	Echo Dot 3rd Generation	Echo Input	

Prices correct at time of going to press

VERDICT

There’s no disputing that this current crop of Echo devices is, collectively, Amazon’s best yet. We had issues with the earlier models, such as the Echo’s high price or the underwhelming functionality of the first Echo Plus, but there are no duds this time around. Where there have been second- and third-generation updates, there have been significant improvements, and even new or unchanged products, such as the Echo Input and Echo Spot, are worthwhile buys.

As such, there’s a lot to recommend, and the best choice will depend on what you want. Starting with the lower-cost products, the Echo Dot 3rd Generation is an impressive

choice, particularly if you want to extend Alexa to multiple rooms in your home. The Echo Input is cheaper still, but this has to be paired with an existing set of speakers. This makes the Echo Dot, with its much improved integrated audio compared to previous generations, the best choice for many.

If you want an Echo device that gives you the full range of features, including voice calls, the Echo Plus 2nd Generation is the best choice. As well as being good for music, with more powerful audio than the Amazon Echo 2nd Generation, it has a built-in smart home hub. This means it can control some devices directly, including Philips Hue bulbs.

Audio enthusiasts, on the other hand, would be better served by the Sonos One than anything in the Echo range. Whether as a solo unit or as part of a seamless multiroom setup, the One’s sound output is simply more pleasurable to listen to than even the Echo Plus and Echo Show. The only real downside is that it doesn’t support all of the Echo features, such as voice calls.

The Echo Show 2nd Generation is easily the better of the two display-equipped Echo devices. The Echo Spot has niche appeal, but the large touchscreen of the Echo Show gives it the greatest flexibility of anything in the range. 📺



# ALEXA SPEAKERS



BEST BUY		RECOMMENDED	
AMAZON		SONOS	
Echo Plus 2nd Generation		One	
★★★★★★		★★★★★	
2	1	1	4
Not stated	Not stated	Not stated	Not stated
7	8	4	6
3.5mm line in	None	None	None
3.5mm aux	None	3.5mm aux	None
None	None	None	None
Wi-Fi, Bluetooth	Wi-Fi, Bluetooth	Wi-Fi, Bluetooth	Wi-Fi
No	No	No	Yes
No	No	No	No
N/A	10.1in	2.5in	N/A
N/A	1,280x800	480x480	N/A
None	5 megapixels	VGA	None
148x99x99mm	174x246x107mm	104x97x91mm	161x120x120mm
780g	1.7kg	420g	1.85kg
Amazon Alexa		Amazon Alexa	
Android, iOS, Fire OS		Android, iOS, Fire OS	
£140		£120	
One year RTB		One year RTB	
www.amazon.co.uk		www.amazon.co.uk	
www.amazon.co.uk		www.amazon.co.uk	
Echo Plus 2nd Generation		Echo Spot	
£220		£169	
One year RTB		One year RTB	
www.amazon.co.uk		www.cramptonandmoore.co.uk	
www.amazon.co.uk		www.sonos.com	
Echo Show 2nd Generation		ONEG1UK1BLK	







# GUARD DUTY

## Security cameras

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Home security cameras are as smart, cheap and easy to install as they've ever been. With this guide to buying your first camera, as well as eight product tests, you too can keep a watchful eye on your home

**THE ABILITY TO** protect your home with security cameras has previously been limited by anything from cost to the bother of installation, not to mention the issue of where you'd save all the footage.

Happily, things are a lot different in 2019. Cameras can cost anything from the price of a nice meal to a few hundred pounds, and they don't always need a professional electrician to set them up – most can just be placed on a shelf and configured with a mobile app. The vast majority of cameras also offer free cloud storage for recorded video, with more comprehensive storage options on paid subscriptions.

Even if you don't live in a crime-riddled area, a security camera can provide peace of mind when you're away for work or on holiday, and as pieces of tech hardware they've never been so accessible. In the following pages you'll find a guide to everything these cameras can do – it's usually a lot more than just recording video – as well as full reviews of eight potential choices, so you can decide which camera delivers the features you'll need.

### LOOKIN' SHARP

Of utmost importance when choosing a security camera is making sure the footage quality is sufficiently high. Being a deterrent to





and the requisite weatherproofing for them to withstand rain or snow, but many are indoor-only, while others might be designed specifically for outdoor use.

You could potentially use an indoor camera to watch an outdoor area by having it face out of a window, and there's nothing strictly stopping you from using an outdoor camera inside, but neither of these are ideal. For outdoor coverage, it's better to place the camera high up on a wall rather than at window-sill level, and even if you drill holes in your interior walls to mount an outdoor camera, you're essentially paying extra for weatherproofing features you won't use.

Our advice is to stick to what the manufacturers intended, although if you want eyes on both the interior and exterior of your house at once, your best bet will be a camera kit that can handle both, such as the Arlo Pro 2. Rather than buying separate indoor-only

recommend) to back up the footage saved in the cloud, there are a few ways this might take shape. Some cameras have microSD card slots or USB ports, into which you can simply install a card, thumb drive or external hard disk, while some might come with a base station. Besides acting as a smart hub for connected cameras, these can also be used for local storage – perhaps a wiser option than saving footage on the cameras themselves, as the base station can be hidden away in a cupboard instead of left out in the open.

### RED ALERT

Don't think you'll have to sift through hours of recordings to find a brief moment of suspicious activity. Home security cameras aren't actually rolling most of the time, but they'll automatically start recording once they detect motion or, on most models, audio. A notification can then be sent to your phone,

## The good news is that even the most affordable cameras can shoot better footage than the kind you might see on the news: black and white, and too blurry to make out faces

and outdoor-only cameras, this will allow you to have multiple cameras on the same network, all controllable from the same app. In many cases, you can buy sets of two or more identical cameras for that very purpose.

### FREE'S A CLOUD

Storage remains one of the more complex aspects of security camera ownership, but that's mainly because of all the different options available; it's all much simpler once you're actually set up.

The best scenario would be your chosen camera coming with a generous amount of free cloud storage, which is typically measured in how long footage will be saved in the cloud for rather than how many gigabytes of footage is stored at once. You'll need a reasonably fast internet connection to make the most of cloud storage, of course, but it has the major benefit over local storage of being immune to physical theft. In other words, a burglar could steal not just your valuables but the camera and its locally saved footage as well, literally robbing you of the evidence.

Be warned, however, that free services rarely keep videos saved for more than a matter of days, and sometimes as little as 24 hours, so you'll need to be quick about saving copies for future viewing. BT's Smart Home Cam also only gives you free storage for still images, and the Ring Stick Up Cam doesn't come with a free allowance at all. If you really like a certain camera but want your footage saved for longer, there are often a range of paid subscriptions that offer better terms, but these can get expensive.

Should you wish to take your chances with local storage, either alone or (as we'd

informing you that something fishy might have occurred, and that a video clip has been recorded and saved.

To avoid this happening every single time you, a friend or a family member walks past, you can generally use a mobile app to set start and stop times for the motion and audio sensors – when you're sleeping or at work, for example. You might still get false positives from things such as pets and passing cars, however. Some cameras are better than others at determining what genuinely is human movement, even if you can change the sensors' sensitivity.

### MAKE SOME NOISE

There are plenty of other features to consider, some more important than others. A night-vision mode is essential: it can reduce video quality, such as recording at a lower frames-per-second rate, but allows the camera to stay in action when darkness falls. Geofencing support is less vital, but still very useful. This can automatically update the camera system when you leave home and arrive back, disabling motion- and audio-detected recording while you're around and re-enabling it when you leave.

Two-way audio is another common feature, with multiple applications. The most obvious is it means the camera can record audio as well as video, potentially making recordings even more valuable as evidence, but it also lets you talk back through your smartphone. Besides offering a safe way of confronting – and possibly scaring off – intruders, this can have more benign uses too, like using your voice to remotely reassure a pet that's been left alone. Some kits can be made to sound a siren, too.

would-be burglars is all well and good, but if the worst happens then having clear footage of the culprits will help police catch the culprits.

The good news is that even the most affordable cameras can shoot better footage than the kind you might see on the news: black and white, single frame-per-second and too blurry to easily make out faces. Every camera we've tested here shoots in full colour, and at no lower than 720p, although 1080p is more common. The latter is preferable in every regard, save for the size of the video files it generates, so you should try to aim for 1080p unless you're likely to be short on storage space. You often have the option of lowering the resolution for this purpose, however.

As for frame rates, anything that shoots at 24fps or higher is ideal. Since you only need a single shot of a perpetrator's face to identify them, it's not ruinous if a camera only shoots at, say, 15fps or even 10fps, but shooting more frames at once gives you a better chance of getting that one shot. Higher frame rates are also better for making out fast movement.

Field-of-view angles also vary between models. Higher is generally better, for the simple reason that you can see more without having to position the camera so far back: ideal for covering the entirety of large rooms.

### TAKING POSITION

Think in advance where you'd want to place your camera or cameras. Many can be placed indoors or outdoors, thanks to flexible stands



## ARLO

## Pro 2

£308 • From [www.amazon.co.uk](http://www.amazon.co.uk)

## VERDICT

If you've got the cash for it, the Arlo Pro 2 is temptingly stacked with features

**ALTHOUGH IT'S NOT** as pricey as its 4K stablemate, the Arlo Ultra, the Pro 2 will set you back a pretty penny. For the base station (which includes a built-in siren) and a single camera, expect to pay £308, and additional cameras come at a premium, too. The two-camera kit is £485, the three-camera kit £605 and the largest four-camera kit £799.

Thankfully, it's not lacking in features. The Pro 2 can stream 1080p video live to your smartphone, and to save you staring at your screen all day long, it has sound and motion sensors and will send alerts if either is triggered. Click on a notification and you'll get a short video showing exactly what triggered it and the option to switch to a live view to find out what's going on.

## SCARE TRIGGER

To minimise on false positives – which can come thick and fast if you have a pet, for example – you can set the camera to work only between certain hours, or to disengage when you're at home by detecting your location. You can also set an alarm to go off from the base station when motion is detected. The alarm goes up to 100 decibels, more than loud enough to startle any would-be burglars.

The Pro 2 is therefore a compelling security product, and a surprisingly versatile one at that. You can keep it in the house or outdoors (the cameras are weather-resistant to the IP65 standard), it can capture footage in night vision, and it lets you mark specific parts of the image for motion detection, just in case there are parts of its line-of-sight you'd rather not monitor, such as swaying trees that could unwantedly set off motion detection.

By default, the footage is only recorded when motion is detected or sharp noises are picked up. This footage is stored in the cloud for seven days, with 1GB of cloud storage included, and the free service supports up to five Arlo cameras before you have to start paying.

If you want to save more footage, you'll have to stump for either the Premier (£64.9 per month) or Elite (£10 per month) subscriptions, which bump up the cloud storage to 10GB or 30GB for 30 or 60 days respectively. You can also plug in a USB pen drive to the hub for local recording if that feels too expensive. This is a slightly better solution than plugging external storage into the camera itself, as if thieves



steal the camera, they won't also be making off with the video evidence.

You can upgrade to non-stop 24/7 recording (CVR) as well, for yet another cost: £7 per camera for 14 days, or £13 for 30 days. It will need to be plugged into the mains for this to work, however.

## ENDURING QUALITIES

On that note, there are a number of ways to power the Pro 2. You can connect it to the mains if you want, but it's designed to work wirelessly and does so brilliantly. The Pro 2

attaches to this magnetically and can be easily pulled down whenever it needs charging.

In our experience, this won't be very often. We checked after 14 days and the camera was still on 65% charge, so a top-up should only be required every six weeks or so. If that still sounds like a drag but you don't want to attach it to the mains, Arlo also makes a solar-panel kit for outdoor cameras. That will cost you another £80, however.

There's no escaping the fact that a relatively high-end smart camera system such as this will prove expensive, although in

## You can connect it to the mains if you want, but it's designed to work wirelessly and does so brilliantly

has a battery inside that can be charged via a Micro USB cable in the camera housing. To ensure this isn't too much of a problem, the Pro 2 ships with a round, half-ball mount that you can either screw to the wall or stick to a surface with an adhesive pad. The Pro 2

fairness to the Pro 2 it's slightly cheaper than the Nest Cam IQ Outdoor. It's also better-featured than the likes of the Ring Stick Up Cam and the BT Smart Home Cam, the latter of which only records in 720p.

That said, if it's a combination of specs and value that you're after, the D-Link DCS-2802KT offers a set of two cameras for £300 – slightly less than the Pro 2's single-camera kit. This also has the flexibility of battery power, at the cost of some higher-level features and a shorter free cloud storage period of 24 hours.

## ARLO THERE

The Arlo Pro 2 is an expensive piece of kit, but it's hard to think of any missteps it makes along the way. The footage it captures is excellent, the motion and audio detection works well, and it's pleasingly flexible.

For some, the sheer number of features on offer will be overkill, but for anyone who wants the extra bells and whistles – literally, given the standard Arlo kit doesn't come with a siren – there's scant else that matches the Arlo 2 Pro for all-round flexibility and quality.





## BT Smart Home Cam



£50 • From shop.bt.com

### VERDICT

**A decent budget alternative to premium smart cameras, but the lack of cloud video storage is a drawback**

**FOLLOWING THE ARLO** Pro 2, the BT Smart Home Cam might come as something of a relief: proof that you can get a smart security camera on the cheap.

In fact, not only has the Smart Home Cam dramatically undercut its rivals, it's done so in quite a sensible fashion, which leaves the core functionality untouched. It's not without its weaknesses, but for those in a relatively crime-free environment, it's a cheap way of getting a little extra peace of mind.

### A DIFFICULT WATCH

Before we get on to what the BT Smart Home Cam does, it's worth focusing on what it doesn't do, because that will quickly tell you whether you need to spend more cash or not. For starters, it's intended for indoor use only: it's pretty flimsy, has no weather protection and only supports power via Micro USB, rather than battery or the fancy Power over Ethernet (PoE) offered by the Ring Stick Up Cam.

Nor will it stream or record footage in 1080p. It's 720p all the way here, meaning streaming is noticeably less sharp, especially in night vision mode, which could make all the difference between the police identifying an intruder or not.

While exposure and detail are pretty good, the frame rate is less so. Sharing the video with YouTube it's encoded at 15fps, leading to a video that's pretty bumpy.

To be clear, nobody should expect Oscar-worthy footage from a security camera, and even the best don't always hit 30fps. But 15fps leads to choppy footage, and hopes of spotting intruders based on it could be hampered as a result.

Perhaps its biggest weakness, however, is how it treats cloud storage. It's there, and it's free, which is a big plus. The downside is that video isn't part of the package. Instead, when it detects motion, it takes a photograph and uploads it to the cloud where it can be reviewed for 30 days before it's deleted.

If you want video of captured motion, you have two choices. First, you can start recording to your phone the second you get a motion alert. That has a fairly obvious weakness: by the time you've reacted, the moment you wanted to capture footage may have gone, so the alternative is better: bung in a microSD card of up to 32GB capacity. With a microSD card in place, the Smart Home Cam will record short bursts of motion-triggered

video, where it can be reviewed and downloaded using the app.

That's all well and good, but it also has a pretty obvious drawback. If burglars enter the house and spot the camera, then removing the evidence is simple. You still have the static shot in the cloud as a backup, of course, but it's not the same as a video.

That's about it for flaws, however, because for the price it's hard to argue with what you're getting. The 720p stream lacks a little detail compared with its 1080p rivals, of course, but it's obviously better than nothing. And, as the camera supports two-way audio, if you do spot intruders in your house you can confront them remotely.

### CHILD FRIENDLY

There's no siren but, given the general flimsiness of the camera itself, that's probably a good thing, unless you want burglars to be convulsed in fits of laughter until the police arrive. In fact, while you can't blast them with

a siren, you can remotely play a range of lullabies and jingles, revealing that you can also use this as a baby monitor, should you be so inclined.

The BT Smart Controls app is relatively barebones, but it gets the job done and is easy to set up. It supports up to 10 separate cameras, which you can label as you please, and lets you set a schedule to disable motion detections, in

case the idea of being watched all the time makes you uneasy. Sometimes we found the app would take a little time to respond, however, especially when trying to access previous days' cloud photo snaps.

Still, for all of the above drawbacks, you have to consider exactly how cheap it is compared with the competition. Compare the £50 price with how much some of the more sophisticated weatherproofed kit costs, and you can see why it might be fine to accept a few drawbacks. The Ring Stick Up Cam goes for £179 and then requires a £25-per-year subscription to store video. That's per camera, with an £80-per-year subscription if you want unlimited cameras.

### IN FOR A PENNY

The D-Link DCS-2802KT is even more expensive, going for £300 for a pack of two cameras. Admittedly this is quite a bit more sophisticated, and includes a premium cloud storage package for video right there in the box. The point is that at £50, you shouldn't expect the world from the BT Smart Home Cam, but it's remarkable how much it can offer at such a low cost. No, the frame rate isn't great, but then you're looking for security, not to capture your most treasured memories.

Unfortunately for BT, however, there's more than one cheap smart camera around. The Neos SmartCam is even cheaper, at an almost unbelievable £20, and can save video to the cloud for up to 14 days at no extra charge. It's still rather basic hardware-wise, and also falls well short of 30fps recording, but unlike the Smart Home Cam it can manage 1080p. If you're after a bargain, Neos's camera is the superior choice.





## D-LINK DCS-2802KT



£300 (twin pack) • From [www.amazon.co.uk](http://www.amazon.co.uk)

### VERDICT

The DCS-2802KT is a flexible system, but if you want the best features, Arlo has the edge

**JUST LIKE THE** Arlo Pro 2, the DCS-2802KT is a security camera system that comes in two parts: a hub that connects to your router, and the camera itself, which can be placed around your home and report back to you when there's movement or sound. Two cameras, in fact – the basic DCS-2802KT kit includes two cameras for a few pounds less than a single Arlo 2 and its hub unit. The cameras are IP65-rated weatherproof and powered by rechargeable batteries, and the system is very easy to set up for DIYers.

It's possible for the hub to support up to four cameras at once, and if you want to expand on the initial two, this works out much cheaper than the Pro 2 as well: standalone cameras are £135 a pop, compared to £237 for each add-on Pro 2 camera.

What's more, the main £300 pack includes a year's subscription to Premium cloud storage, making it a keenly priced offering by high-end standards. However, it's also not quite as fully featured as Arlo's kit. Unlike with the Pro 2, the DCS-2802KT cameras can't be plugged into the mains, and there's no support for constant video recording (CVR) footage.

### STUCK INSIDE

These cameras also lack the removable batteries of the Pro 2's, meaning that there will always be downtime when they need charging; with the Pro 2, you can avoid this just by keeping a set of charged spares to hand. Lastly, while both systems support motion detection, only Arlo's allows you to mark out specific parts of the view for motion detection to prevent false positives.

Still, there's a lot to like here. The two cameras that come in the box are easy to set up, and they're very effective once up and running. They're charged via Micro USB, and pop magnetically on to a half-ball mount that can be screwed into the wall.

That may sound like a dream design for burglars, but even if they do manage to pop the camera off the wall, footage of them doing so will already be in the cloud and ready to view on your phone.

Downtime while charging won't be such a major problem either, as the cameras rarely need to be recharged. After a full 21 days, the battery gauge on one camera had dropped by 11%, and the other by 15%. Scaling that up to the least optimistic estimate means you should be looking at charging every three-and-a-half months or so.



The downside is that, as the battery can't be removed, the camera will have a limited lifespan: once the battery is exhausted and can't hold a useful amount of charge any more, you'll have to throw away the camera.

### CLEAR VIEW

For the most part, however, you can just forget that they're there. You can watch a livestream on your phone – although in our experience it takes a lot of buffering before anything shows up, if it decides to at all – but the real appeal is the motion and noise detection. Any time anything moves within its field of vision, the camera snaps a short bit of video and logs it, with an instant notification so you can check it right away.

These clips are recorded in crystal-clear 1080p and at 24fps, which is plenty smooth enough. There's a night vision mode, too, which works impressively and has a long effective range of 7.5 metres.

Footage is stored in the cloud for a certain period of time depending on how much you're prepared to spend in terms of a subscription. You don't need to decide right away, as a year's worth of the Premium plan is included in the box, which

gives you unlimited clips from up to five cameras, stored for two weeks.

After your year is up, you'll revert to the free plan, which drops the maximum number of connected cameras to three and holds on to captured footage for a mere 24 hours. The Basic plan ups this to seven days of storage for £2 per month or £22 per year, which is pretty reasonable, or you could continue with the Premium offering for £4.49 per month or £44 annually.

If you really want to push the boat out, the Pro package supports up to 10 cameras for 30 days, and comes in at £9 per month or £88 per year.

You might not need any kind of subscription at all, however, as you can download recorded clips to your phone at any point up to their scheduled deletion. Given that notifications are instant, this should be sufficient for most people who spot something out of the ordinary they may need to send to the police. Yet another alternative is connecting your own storage drive to the hub via microSD or USB.

Two more features deserve a mention. First, the hub has a very loud siren built into it, which can blast out over 100 decibels when movement is triggered. You can set this to be on or off, depending on whether you're at home or not. The cameras also come with a two-way microphone, meaning you can speak to people if they unexpectedly appear at the other end of the camera.

### SAFE BET

Awkward name aside, the D-Link DCS-2802KT is a great security camera system that will be more than enough for most people's needs. The price is decent for a wireless camera setup, the batteries last for ages and the year's worth of premium cloud storage is a very nice touch indeed.

The Arlo Pro 2 offers a bit more, but it does so at a price and if those little extras – especially CVR – are super-important to you, then it may be worth paying the extra. For everybody else, D-Link offers peace of mind at a more competitive price.





# HIVE View



£179 • From [www.hivehome.com](http://www.hivehome.com)

## VERDICT

**It's wonderfully designed, but the View suffers from unreliable motion detection and delayed notifications**

**THE FIRST HIVE** camera, fittingly called the Hive Camera, was a basic affair that could only record to an SD card. Its successor, the Hive View, is much more in line with modern expectations for a smart security camera, able to save recordings in the cloud and away from prying hands.

A single camera costs £179, with 24 hours of footage history available for free. An extra £4 per month, however, will get you 30 days of footage history and 25% off the cost of any cameras when bought together, so if 24 hours doesn't sound like enough then it's best to get the subscription up front.

The physical design of the Hive View is fabulous. It's beautifully built and looks much more modern and attractive than most home security cameras. The camera unit attaches to the stand magnetically and allows the camera to be adjusted up and down, and the base is magnetic too, so the camera can be attached to metal surfaces as well as placed on shelves, in a similar way to the TP-Link Kasa Cam KC120.

Power is supplied via a long USB cable that can be plugged into either the base or the camera, and once set up and connected to your home Wi-Fi, the View records 1080p footage through its 130° wide-angle lens. There's no weatherproofing; this is an indoor-only camera.

## ACTION CAM

Setup is a lot easier than it was at launch – now, you can do it all through the Hive app. Once up and running, you'll find the camera listed in the app as well, alongside any other Hive smart home products you might have. Here, you can view a live video stream, manage your camera's settings (from adjusting motion sensitivity to the resolution at which video clips are streamed and recorded) and view video clips, which have been triggered by motion and audio events. The Hive View can be set to record and stream at 720p (down from 1080p), which could be handy if your internet connection can't handle Full HD.

Beyond video clip recording and live streaming, however, there aren't many extra features. One, called Hive Actions, allows you to link different Hive devices. For example, when the camera detects motion, it can trigger your Hive light bulb to switch on for a set amount of time, and you can combine these actions to create much more complex actions.

That's about it, however. The app can't be disabled and enabled based on the GPS position of your phone, unlike Nest Home/Away Assist, which can tell when you've left the house and when you come home again by tapping into your phone's sensors. Instead, you have can only use a schedule.

Video clips can be downloaded to your phone, so that you can save any evidence that you need.

## SPOT THE DIFFERENCE

We tested the View in different scenarios with mixed results. First, the good news: it was great having a live feed from the camera that includes audio (only when enabled through the settings), and the app's vertical timeline makes it simple to identify and playback motion-triggered clips.



At 1080p, recordings have plenty of detail and are sharp enough to make out facial details, although the sensor sometimes struggled to cope in backlit scenes, making people look very dark. There are other drawbacks, too. Once you've tapped a newly created clip, it can take several minutes before you're able to access it.

Motion detection, too, was very poor. The View is supposed to have person detection, meaning the motion sensor is only triggered when it detects a moving person and not just a pet or a windblown plant, but when we walked past a doorway well within the camera's field of view, it failed to recognise anything had moved at all.

Night vision mode is much more impressive. The View can still pick up plenty of detail in the dark, and night mode kicks in automatically as soon as the lights turn off.

Phone notifications are good when they work, but half the time we ended up waiting in vain for one to pop up. This, according to Hive, is a feature: it doesn't want to overcrowd your notification area, so you'll only receive a notification every 30 minutes. We appreciate the sentiment, and the app will still log everything, but if a break-in was occurring we'd rather be informed straight away. The only way to make sure this happens is to have the app open constantly, as new detected motions pop up automatically, but that's not really a feasible workaround.

## LOST SIGHT

The View may not be the first security camera Hive has produced but it's definitely an improvement in terms of style and features. However, it has some serious shortcomings as well. The motion detection is patchy, and Hive's choice of when to display a notification is illogical.

That's highly unfortunate, as the View could have been a fantastic way of getting high-end functionality for a lot less than the Arlo Pro 2 or the D-Link DCS-2802KT. As it turns out, if you want that level of quality, you'll simply have to pay more, although the Kasa Cam KC120 is an attractive alternative at £76. It, too, has a flexible magnetic stand, and footage is saved in the cloud for twice as long as with the View.



## NEOS SmartCam



£20 • From [shop.neos.co.uk](http://shop.neos.co.uk)

### VERDICT

The SmartCam isn't the most technically advanced camera, but at this price it's incredibly well equipped

**SO FAR WE'VE** seen how expensive it can be to get a smart security system up and running; even if you opt for the relatively affordable BT Smart Home Cam, there's the added monthly cost of a subscription to actually let you review video clips instead of just still images.

The underlying idea is that you can't put a price on security, but the Neos SmartCam shows that this price doesn't have to be very high. It's only £20 but shoots at 1080p, has a night vision mode and free cloud storage for video footage.

Free cloud storage isn't a particularly rare bonus, of course. It's often offered with greater limitations than paid subscriptions, and there's always the risk that this perk can be removed at a later date, which is exactly what happened with Y-Cam, which described free storage as unsustainable. This may or may not happen to Neos, but for the time being, a freebie is a freebie. How, though, does the SmartCam manage to pack in so much for so little money?

### ALL IN ONE

It's partly because the SmartCam doesn't require its own hub. The package is remarkably small, with just the cuboid camera, a plug and a wire in the box. Second, this is a camera that is strictly for indoor use. It's not weatherproofed, and is completely wired with no battery-powered option.

Otherwise, everything is present and correct. Besides the night vision mode to capture motion after dark, there's also a microphone and speaker so you can chat to any intruders that cross the SmartCam's path. It responds automatically to motion and sounds, and automatically uploads footage to the cloud without any need for subscriptions.

This last quality comes with some strings attached: the camera only captures clips of 12 seconds in length, and then will not take further video for another five minutes. This is clearly a significant limitation, although you can record live from the app if you need some more substantial footage. It theoretically means you could capture 12 seconds of a burglar pilfering through your stuff, but then see the footage cut off before they turn and face the camera, and they may be gone before the five minute cooldown time ends.

Cloud footage is stored for 14 days, which (unlike the clip length) feels generous enough. If you haven't downloaded the key clips after 14 days, you probably don't care that much

about the video. Still, it's a shame that Neos doesn't offer more customisation here, even if it were to cost a little extra each month to do so.

### YOU'RE NICKED

There is another option, although for now it lacks flexibility. There's a microSD card slot in the camera's underside, and when a card is inserted, the SmartCam will enable continuous recording to the storage in one-minute bursts. When the card is full, it records over the earliest footage.

The camera is well designed for such a cheap device; not only is it compact, but it also sits on a stand, which allows a great deal of flexibility in terms of where it's aiming

There are a couple of reasons why this isn't an ideal solution. First, at the time of writing, footage captured on the card can't be viewed within the app. Instead, you have to physically remove the microSD card and insert it into a laptop or PC to see what's on it. That, in turn, means that if a burglar steals the camera, then they also steal the evidence with it. That said, it's not a binary choice between cloud and microSD, so some footage should still be backed up.

As for the 1080p video, the quality is pretty reasonable during daylight hours. Footage is captured at 15fps, which makes the footage a lot choppy than you'd get on

a 30fps device such as the TP-Link Kasa Cam KC120 or even the 24fps D-Link DCS-2802KT, but it's clear enough to make out faces. This is also true in night-vision mode, except it drops even further to 10fps.

One of the SmartCam's smarter features is the green box that appears in playback, highlighting the part of the scene that triggered the motion sensor. Given we've seen completely empty scenes picked up on other cameras before, it's a nice confirmation that there's definitely nothing in shot.

That's not the last of the SmartCam's qualities, either. The camera itself is very well designed for such a cheap device; not only is it compact and nondescript, but it also sits on a pull-out hinge/stand, which allows a great deal of flexibility in terms of where it's aiming. The legs are magnetic, meaning it can stick to nearby surfaces, and Neos even includes a metal stand and perfectly cut sticky tape so you can make your own compatible surface.

### ON THE FENCE

We're not so fond of how the mobile app's setup process demands an awful lot of intrusive-sounding information, such as your phone number and address, but there is a reason for this: the SmartCam supports geofencing, so it can automatically arm itself when you leave the house and disarm when you come back, based on your phone's GPS. You don't have to use it, and it's off by default, but it's yet another surprisingly sophisticated feature for a camera so cheap.

The so-so recording quality and limitations on cloud storage are issues that must be lived with, but they don't stop the Neos SmartCam from being a stone-cold bargain at this price. If you want some peace of mind without paying the earth or sacrificing features, it's near enough impossible to beat.





# NEST

## Cam IQ Outdoor



£329 • From [nest.com/uk](https://nest.com/uk)

### VERDICT

**An expensive, but super-smart, well-designed outdoor camera with excellent image quality**

**THE NEST CAM IQ** (Shopper 363), with its 4K sensor and facial recognition, proved to be the best-quality and smartest security camera we'd ever tested at the time. The Nest Cam IQ Outdoor sees the company back with more of the same, this time in a weatherproof model.

Nest joined the outdoor security market with the rather neat Nest Cam Outdoor, which was the easiest external camera we'd ever installed. Thanks to its magnetic mount and use of an outdoor power socket, it could be installed in a matter of minutes; unfortunately, this also made it easier to tamper with.

### CABLE TIED

With the Cam IQ Outdoor, Nest has made the model harder for thieves to remove, but also slightly trickier to install. Now the camera has to be powered by the internal USB Type-C power adaptor, which means drilling a hole through your wall. For maximum security, you can feed the 7.5m cable through the rear of the camera's mount, leaving nothing visible from the outside.

The alternative is that you can run the USB cable outside for a bit, although this means that someone could more easily cut the power to it.

With the Nest Cam IQ Outdoor, a hex key must be used to remove the camera from its mount; this kind of tampering is going to be noticed and recorded on video.

Although the body of the camera is IP66 rated, making it water-resistant and capable of operating in temperatures from -40°C to 45°C, the internals are the same as those of the Nest Cam IQ.

That means that you get a 4K sensor. Although video is recorded in 1080p, having a 4K sensor has two main advantages. First, the video quality should be better, as more detail is captured. Second, you get a 4x zoom into a 1080p picture. Nest uses that with its Supersight tech, which automatically zooms in and tracks suspicious activity.

Cleverly, the camera captures both the zoomed-in view and the full image, so you can switch between the detail and the full picture. As with the Nest Cam IQ, the Outdoor version handles this brilliantly, creating a dynamic image that lets you see exactly what's going on.

Video quality is outstanding, too. Thanks to HDR and that 4K sensor, there's a huge amount of detail in the picture, making this by far the best-quality outdoor camera that we've tested.

At night, the Nest Cam IQ Outdoor switches on its IR LEDs to light up the night. There's a slight reduction in visual range, and the image gets a little softer, but quality and sharpness is still better than with rival 1080p models.

### GETTING ID'D

Buy a Nest Aware subscription and you get additional features, including the ability to create motion zones and Google's facial recognition tech to distinguish friend from foe. Faces that you recognise can be marked as such, adding a name to the person, and faces already recognised with the Nest Cam IQ can be carried over as well.

With this information, the Nest Cam IQ Outdoor can send you notifications that specify if a known or unknown person is spotted; there's a catch-all person alert, too, for when no face is detected.

**The Nest Cam IQ Outdoor is undoubtedly expensive, but it's also the best-quality external security camera we've tested**

Facial recognition is very powerful, picking us up from a variety of angles with and without glasses on. The more the camera spots you, the better it works. But Nest Aware can and will get it wrong, such as by detecting a known face as a new person. More often at night, the camera can struggle to pick out faces, generating a person alert.

Nest has improved the detection alert settings. Now, with a Nest Aware subscription,

for each activity zone that you set to monitor, you can choose the type of alerts that you want: people and general motion. That way, you can narrow down the number of alerts you get. It's a shame, however, that you can't choose to be warned only about strangers, ignoring recognised people.

To give the camera its credit, motion detection is spot on, avoiding false positives when it spots general movement (such as

foliage blowing in the wind) and accurately picking up people.

There's also sound detection built in, and you can set the camera to listen out for any combination of general noise, people talking and dogs barking. Again, this is impressive, and we weren't flooded with false alerts.

### SUPER SUB

Nest Aware used to be expensive, but the entry-level subscription now gives you five days of constant video recording for £4 a month, or £40 a year. That's more than enough for most people. Unfortunately, if you try to get by without a subscription, you'll only be able to watch footage from the past three hours in the app, so you'll need to be quick if you do catch a crime on camera.

Still, Nest Aware is the best cloud service we've tested, with the app letting you effortlessly scroll through your video history, or find a specific alert using the alert view.

The Nest Cam IQ Outdoor is undoubtedly expensive, but it's also the best-quality external security camera we've tested. With the new cheaper Nest Aware subscription, it's an easy camera to recommend.





# RING

## Stick Up Cam



£179 • From [www.amazon.co.uk](http://www.amazon.co.uk)

### VERDICT

The Stick Up Cam is a versatile and high-quality security camera, but the lack of free video storage disappoints

**RING IS PROBABLY** best known for its video doorbells, which can themselves act as smart security cameras – albeit small, static ones with a limited view.

Expanding into dedicated security cameras therefore makes a lot of sense for Ring. However, while the Stick Up Cam is generally a fine effort, it falls down on its subscription prices.

That's a pity, because there's a huge amount to be positive about with the Ring Stick Up Cam, from the brilliant design to the quality of the footage it can capture.

First, the design: the camera itself is a small, cute-looking cylinder with a stand that, out of the box, sits below it. Pop it on a shelf and it's ready to go, and you can adjust the angle to your liking.

The clever bit is that the stand can be adjusted with the bundled screwdriver to stick out of the back for wall mounting, or rotated a full 180° for mounting to the ceiling. The base even has a built-in spirit level to make sure you're attaching it on the level. It's extremely versatile and can be set to point wherever you want it.

The fact that this version is wired may impose some limitations, depending on how busy you want to get with a drill. There is a battery-operated version available for the same price but, for some reason, it has a slightly narrower field of view: 115° compared with the wired version's 150°. It also lacks the ability to set custom motion-detection zones, which the wired model can.

### FUEL LINE

Being IPX5 rated, the Stick Up Cam can be installed indoors or outdoors, and you don't need to worry about good lighting as it switches to night vision when in the dark. Setup is a cinch: you can either power it via Micro USB or, if you need a bit more range, Power over Ethernet (PoE). The latter is a great little bonus feature: not only does it mean you can power the camera from an improbably long distance (PoE works over distances up to 100 metres, so practically speaking the only limit is the length of lead you're willing to buy), but you only need one cable, and you don't need to worry about Wi-Fi signal strength, either.

Once set up, the Stick Up Cam will detect motion and alert you via the app. You can adjust these alerts to your own schedule, so you only get a prod at night or when you're at work, and motion sensitivity can be adjusted

to the point where it reacts only to human movement and not small pets.

The 1080p footage quality is very good, and as with Ring's doorbells you can use two-way communication with a tap of the app, allowing you to warn intruders they're on camera.

You can also trigger a siren, although since there's no base station the sound comes straight from a tiny speaker in the camera, and as such sounds a touch reedy. The app warns you when you trigger it that it's loud enough to alert neighbours, so it was something of a let-down to find that it's barely loud enough to be heard in the next room.

### SQUEEZED OUT

Mostly, however, the Stick Up Cam is an admirable attempt on the hardware and software sides. Where things start to get offputting is the Ring Protection Plan subscriptions or, to be more specific, the value they represent.

There are three tiers: free, £25 per year and £80 per year. The most expensive option supports an unlimited number of Ring products and automatically stores motion-triggered video recordings for 30 days, which

is fine, but not terribly tempting when D-Link and Neos give you two weeks for free.

The £25 option is cheaper, and still provides 30 days of storage, but only for a single camera – potentially a serious limitation if you want to watch more than one room. The free model sends you motion alerts, lets you watch a livestream of the

camera and use the two-way microphone, but it doesn't record or store footage, or let you do anything with that footage.

The free version is probably fine for a doorbell, as the two-way communication and live alerts are all you need, but a security camera is pointless if you can't save recordings. If you were at work and got a motion alert showing a burglar wandering around your living room, you can call the police or remotely set off the alarm but if they run away before the police arrive, you'll have no footage to help them apprehend the perpetrator. Even the Nest Cam IQ Outdoor offers a few hours of after-the-fact playback.

Second, you need at least three Ring devices to make the £80 per year plan worth buying; otherwise, it's cheaper to buy three individual plans at £25 each. That's bizarre, and even though the Arlo Pro 2 and D-Link DCS-2802KT are both more expensive systems to buy outright, their free cloud storage allowances are far more generous.

### UP IS DOWN

The Ring Doorbell range is excellent and very easy to recommend, because you don't really need the subscription service to get the most out of it. For the Stick Up Cam, the opposite is true: compared to the competition, Ring subscriptions start to add up very quickly indeed.

That's a real shame, because there's really nothing too negative to say other than that. The Ring Stick Up Cam is a neatly designed, versatile product with a good app and high-quality footage. Just be aware that to get the most out of it, you'll need to pay a lot more than the £179 asking price over the lifetime of the product.





## TP-LINK

### Kasa Cam KC120



£76 • From [www.amazon.co.uk](http://www.amazon.co.uk)

#### VERDICT

**Slightly over-the-top motion detection aside, the Kasa Cam KC120 is a quality smart camera**

**AS USEFUL AS** security cameras can be, whether it's for deterring thieves, collecting evidence or monitoring your home while you're out, they're not always the simplest of devices. Besides the expected hardware differences, there's also the matter of cloud storage plans, which can get confusing in terms of what you can save and for how long. The TP-Link Kasa Cam KC120 aims to simplify things, offering two days of free cloud storage for video footage and a flexible stand that makes it easier to install anywhere. Anywhere indoors, at least.

Standing on a tall stick of a stand and decked out in black plastic, the TP-Link Kasa Cam KC120 is a fairly inoffensive-looking security camera. Importantly, the stand is practical, giving a good degree of adjustment, including the ability to point the camera straight down without the stand falling over.

If you'd rather put the camera up on a wall, there's a sticky metal plate in the box, on to which the stand's magnetic base attaches. This gives you a fair amount of flexibility to capture what you need. With a 130° lens, you can capture most of a room from practically anywhere, too.

Installation is pretty straightforward once you've downloaded the TP-Link Kasa app. This is the same app that's used to control other Kasa devices, such as TP-Link smart plugs and light bulbs. Having everything in one place makes a lot of sense and means that you don't need to get a phone full of different apps.

#### TWITCHY FEELING

Hooking the camera up to a wireless network proved incredibly straightforward. The app generates a QR code, which you show to the camera; it pulls in your network name and password from this, quickly connecting to your home network. The KC120 supports 802.11ac networks, so you'll have no trouble connecting to a modern network to get the fastest streaming speeds. This gives the KC120 an advantage over the BT Smart Home Cam and Neos SmartCam, which use the slower 802.11n standard.

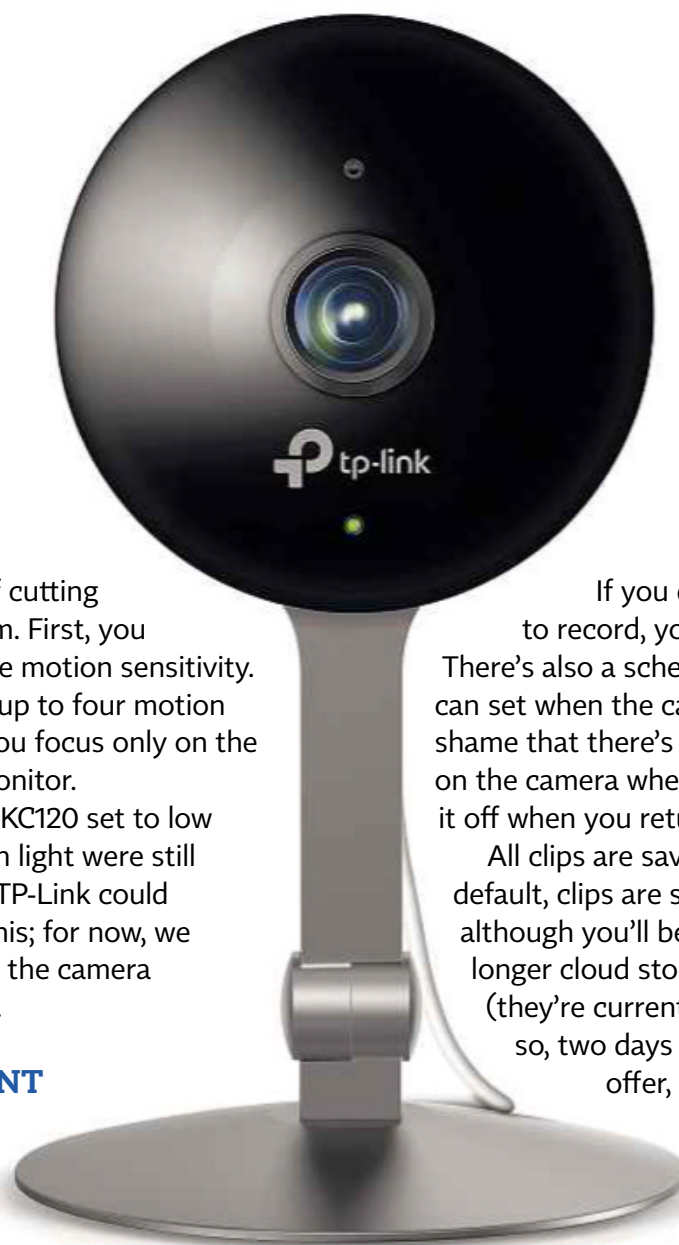
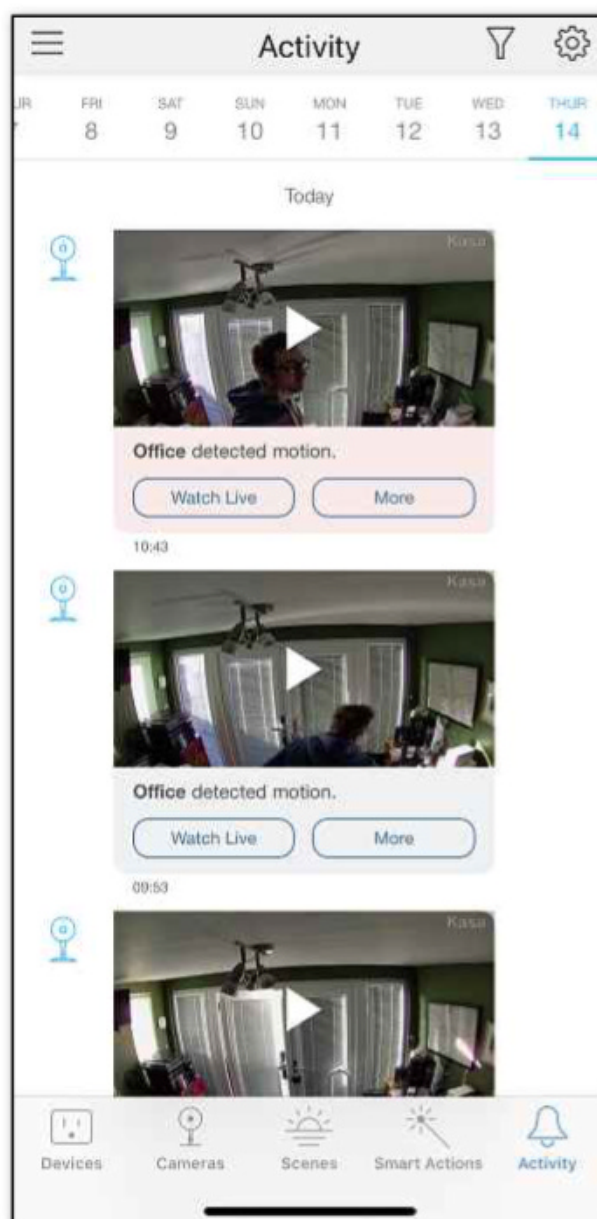
Once connected, the camera is ready to go, and starts monitoring the surrounding area for motion. The default settings aren't great, however. Pointing the KC120 towards a door covered in blinds, the changing sun or the shadows caused by moving cars would trick the KC120 into thinking that there was movement inside.

There are ways of cutting down on this problem. First, you can simply reduce the motion sensitivity. Second, you can set up to four motion alert zones so that you focus only on the areas you want to monitor.

Even so, with the KC120 set to low sensitivity, changes in light were still detected as motion. TP-Link could work on improving this; for now, we recommend pointing the camera away from a window.

#### WAKING MOMENT

The KC120 can also be set to start recording when it detects loud noises. The accuracy of this will depend on where you place the camera. If you live somewhere quite noisy, it's probably not a very useful feature; if you live somewhere quieter, you'll find that you get fewer alerts.



If you don't want the camera to record, you can turn it off.

There's also a schedule option, so you can set when the camera is active. It's a shame that there's no geolocation to turn on the camera when you go out and turn it off when you return, however.

All clips are saved to the cloud. By default, clips are stored for two days, although you'll be able to upgrade to longer cloud storage plans in the future (they're currently not available). Even so, two days is a fairly generous offer, even if it's not up in

the same league as what Arlo and Neos provide (which is seven days and 14 days respectively).

Clips can be viewed in the app. The interface is quite simple and clear. You can use the date picker at the top to find the date you're interested in, then scroll through the list to find the one you're after. Clips can be downloaded to your phone, which is handy if you want to save the evidence.

By default, the KC120 was set to record at 720p, although you can override this option to increase footage to the full 1080p quality. Image quality was excellent: during daylight hours, video was sharp and detailed, making it easy to identify faces clearly. At night, the camera turns on its IR lights. The image gets a bit softer, but quality remains high.

You can watch live and even use two-way talking to have a conversation with anyone you can see, which could be a handy way of scaring off a burglar.

#### RIGHT AT HOME

What the KC120 lacks is a suite of more advanced features. For example, there's no facial recognition in the video stream, nor is there the option to record only people rather than any motion. Ultimately, that may not matter, as the KC120 is a simple but high-quality camera. Besides, there's no guarantee of getting all these features on more expensive cameras. The Hive View, for instance, can tell when there's a person in the frame, but it doesn't have actual facial recognition.

With a relatively affordable price, a flexible stand and two days of free cloud storage for clips, TP-Link's camera is great value; it just needs a bit of work on its motion-detection algorithm.





Award	RECOMMENDED				
Manufacturer	ARLO	BT	D-LINK	HIVE	
Product	Pro 2	Smart Home Cam	DCS-2802KT	View	
Rating	★★★★☆	★★★★☆	★★★★☆	★★★★☆	
HARDWARE					
Indoor/outdoor	Both	Indoor	Both	Indoor	
Dimensions	79x49x71mm	125x83x58mm	150x65x134mm	145x88x88mm	
Video resolution	1080p	720p	1080p	1080p	
Imaging	Colour	Colour	Colour	Colour	
Lens	130°	120°	140°	130°	
Networking	802.11n	802.11n	802.11n	802.11n	
Geofencing	Yes	No	No	No	
RECORDING					
Local storage	USB	MicroSD	MicroSD, USB	None	
Free cloud storage	Yes (7 days)	Still images only (30 days)	Yes (14 days for one year, then 24 hours)	Yes (2 days)	
Motion detection	Yes	Yes	Yes	Yes	
Audio detection	Yes	Yes	Yes	Yes	
Night vision	Yes	No	Yes	Yes	
BUYING INFORMATION					
Price	£308	£50	£300 (twin pack)	£179	
Supplier	www.amazon.co.uk	shop.bt.com	www.amazon.co.uk	www.hivehome.com	
Details	www.arlo.com	shop.bt.com	eu.dlink.com	www.hivehome.com	
Warranty	One year RTB	Two years RTB	Five years RTB	One year RTB	
Part code	VMS4130P-100EUS	88438	DCS-2802KT-EU	UK7001720	

Prices correct at time of going to press

VERDICT

While it’s a slight shame that there’s no single security camera that does it all, there are multiple models that each cater to different needs and budgets – which, in a way, is even better.

The Nest Cam IQ Outdoor is our Best Buy winner, largely thanks to its impeccable image quality and smart connectivity. The former makes it a particularly capable crime-fighter, as it can zoom in on details without sacrificing resolution, and the latter ensures it can slot neatly into an existing smart home system. It’s expensive and not

as flexible as cameras that can go indoors or outdoors, but it’s still a fantastic product.

At the opposite end of the scale is the Neos SmartCam. At just £20, it’s incredibly good value, especially as you get a full two weeks of cloud storage for free. By recording at 1080p, it’s sharper than the BT Smart Home Cam and, despite the price, you’re not losing out on key features such as night vision. There are some limitations – stored clips can only be a few seconds long, and are only recorded at 15fps – but these don’t necessarily get in the way of its usefulness.

The Arlo Pro 2 security camera also impresses. It’s much more of an all-rounder than either the Cam IQ Outdoor and SmartCam, being able to work indoors or outdoors and coming packed with extra hardware features. As long as you can find room for it, the inclusion of a base station proves very handy, both for locally storing clips and for blaring a siren at intruders. The Pro 2 covers the basics very well, too: video quality is high, and your free cloud storage allowance goes on for a generous seven days.





RECOMMENDED	BEST BUY		
NEOS	NEST	RING	TP-LINK
SmartCam	Cam IQ Outdoor	Stick Up Cam	Kasa Cam KC120
★★★★★★	★★★★★★	★★★★☆☆	★★★★☆☆
Indoor	Outdoor	Both	Indoor
56x50x50mm	128x93x93mm	97x60x60mm	79x79x137mm
1080p	1080p (4K sensor)	1080p	1080p
Colour	Colour	Colour	Colour
110°	130°	150°	130°
802.11n	802.11ac	802.11n	802.11ac
Yes	Yes	No	No
MicroSD	None	None	None
Yes (14 days)	Yes (3 hours)	No	Yes (2 days)
Yes	Yes	Yes	Yes
Yes	Yes	No	Yes
Yes	Yes	Yes	Yes
£20	£329	£179	£76
shop.neos.co.uk	nest.com/uk	www.amazon.co.uk	www.amazon.co.uk
shop.neos.co.uk	nest.com/uk	en-uk.ring.com	www.tp-link.com
One year RTB	One year RTB	One year RTB	One year RTB
NS-CAM-02	Nest Cam Outdoor	Stick Up Cam	KC120



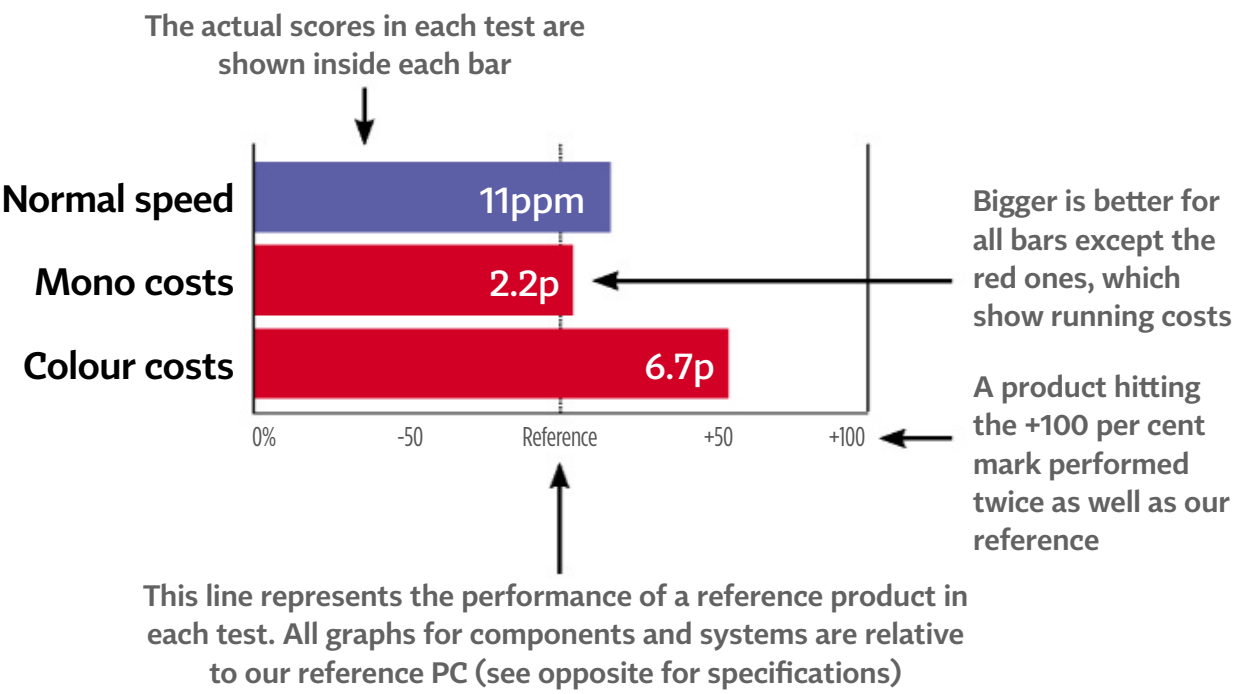


# How we test

Find out how well products perform with the help of *Computer Shopper's* comprehensive tests

**COMPUTER SHOPPER'S REVIEWS** use some of the most exhaustive testing procedures you'll find in any PC magazine. Every product is subjected to qualitative and quantitative tests that show how it performs in practical use. Graphs for performance, battery-life scores and costs are used in the *Reviews* section, as shown on the right. Look in the 'Summary of tests' table (below) for details of each test we run.

For PCs and laptops, we evaluate performance using our own custom benchmarking suite. See opposite for a description of our benchmarking software and game tests.

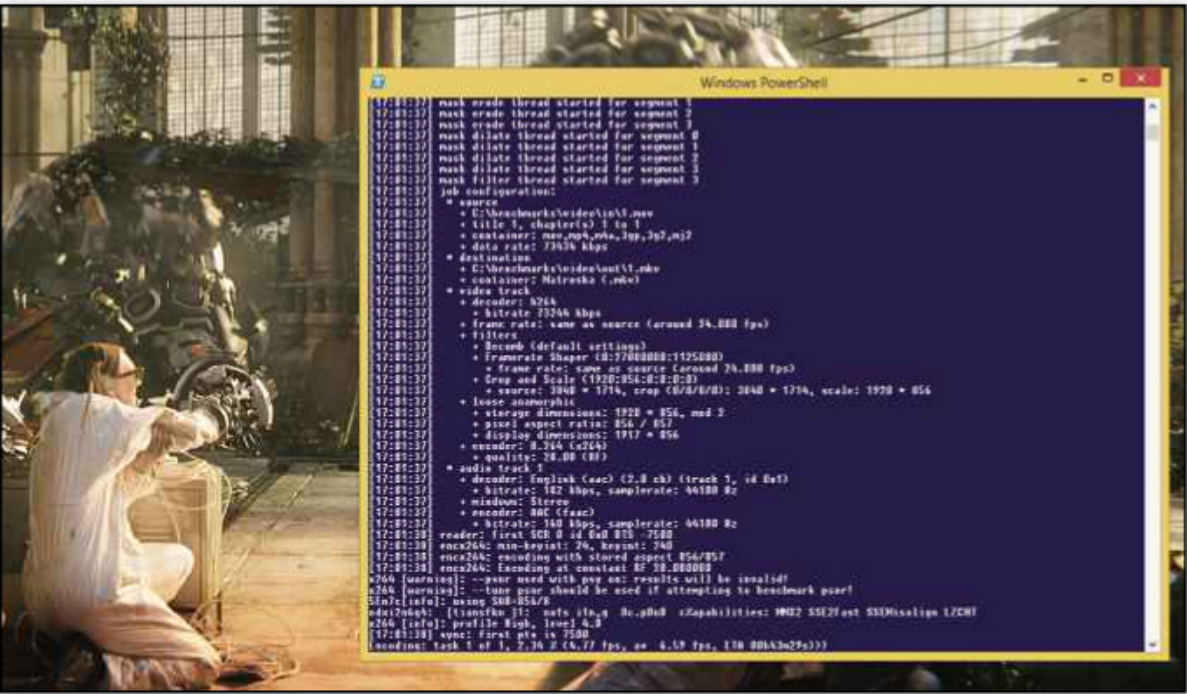


## SUMMARY OF TESTS

PC SYSTEMS & GAMING LAPTOPS	
Windows overall	Average speed across numerous demanding tasks
Multitasking	Speed when running simultaneous applications
Dirt Showdown (1080p)	Frames per second at 1,920x1,080, 4xAA, Ultra detail
Metro: Last Light Redux (1080p)	Frames per second at 1,920x1,080, SSAA, Very High detail
LAPTOPS	
Windows overall	Average speed across numerous demanding tasks
Multitasking	Processor-intensive multitasking test
Dirt Showdown (720p)	Frames per second at 1,280x720, 4xAA, High detail
Battery life	Run time in minutes for continuous video playback
SMARTPHONES/TABLETS	
Battery life	Run time in minutes for continuous video playback
PRINTERS AND MFPs	
Mono text speed	Pages per minute for correspondence-quality text
Mixed colour speed	Pages per minute for presentable text and graphics
Mono page cost	Running costs expressed as pence per page
Colour page cost	Running costs expressed as pence per page
DIGITAL CAMERAS	
Battery life	Number of shots from full charge
CAMCORDERS	
Battery life	Run time in minutes for recording
ROUTERS	
Laptop 2.4GHz 5m	Mbit/s at 5m with 802.11ac laptop on 2.4GHz band
Laptop 2.4GHz 1 floor	Mbit/s 1 floor up with 802.11ac laptop on 2.4GHz band
Laptop 2.4GHz 2 floors	Mbit/s 2 floors up with 802.11ac laptop on 2.4GHz band
Laptop 5GHz 5m	Mbit/s at 5m with 802.11ac laptop on 5GHz band
Laptop 5GHz 1 floor	Mbit/s 1 floor up with 802.11ac laptop on 5GHz band
Laptop 5GHz 2 floors	Mbit/s 2 floors up with 802.11ac laptop on 5GHz band
NETWORK-ATTACHED STORAGE	
Large files	Average MB/s for read/write of 100MB large files
Small files	Average MB/s for read/write of 100MB small files
HARD DISKS	
Huge files	Average MB/s for read/write of a single 2.5GB file
Large files	Average MB/s for read/write of 2.5GB of large files
Small files	Average MB/s for read/write of 2.5GB of small files
PROCESSORS	
Windows overall	Average speed across numerous demanding tasks
Multitasking	Speed when running simultaneous applications
Dirt Showdown (720p)	Frames per second at 1,280x720, 4xAA, High detail
MOTHERBOARDS	
Windows overall	Average speed across numerous demanding tasks
Multitasking	Speed when running simultaneous applications
Dirt Showdown (1080p)	Frames per second at 1,920x1,080, 4xAA, Ultra detail
Dirt Showdown (720p)	Frames per second at 1,280x720, 4xAA, High detail
GRAPHICS CARDS	
Dirt Showdown (1080p)	Frames per second at 1,920x1,080, 4x MSAA, Ultra detail
Tomb Raider	Frames per second at 1,920x1,080, SSAA, Ultra detail
Metro: Last Light Redux	Frames per second at 1,920x1,080, SSAA, Very High detail



BENCHMARKS



SHOPPER BENCHMARKS

Our benchmark suite uses open-source software that runs on Windows, macOS and Linux systems. This lets us use objective results to compare PCs and laptops, no matter which operating system they run. It's designed to test each computer to its limit, using a combination of intensive image-editing, video-encoding and multitasking tests.

We ran the tests on our reference PC, which has an Intel Core i5-4670K processor, 8GB of DDR3 RAM and an AMD Radeon R7 260X graphics card. We normalised our results so this PC had a score of 100. This makes it easy to draw comparisons between test systems.

The resulting overall score is shown at the bottom of every PC and laptop review. As we use the same tests in our standalone and group test reviews, you can compare the performance of any computer, whether it's a hybrid, laptop or desktop, from both sections of the magazine.

3D BENCHMARKS

DIRT SHOWDOWN

Dirt Showdown is a cracking racing game that makes good use of DirectX 11's fancy graphical effects. You'll want at least 30fps for smooth racing.



TOMB RAIDER

With the ultra-demanding Super-Sampling Anti-Aliasing (SSAA) enabled, 2013's Tomb Raider reboot is a great indicator of mid-range performance.

METRO: LAST LIGHT REDUX

Our most demanding graphics test uses tessellation, SSAA and massive textures to give even high-end cards a thorough workout.



RATINGS & AWARDS

Computer Shopper rates products out of five:

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Excellent

★★★★☆  
Very good

★★★☆☆  
Good

★★☆☆☆  
Below average

★☆☆☆☆  
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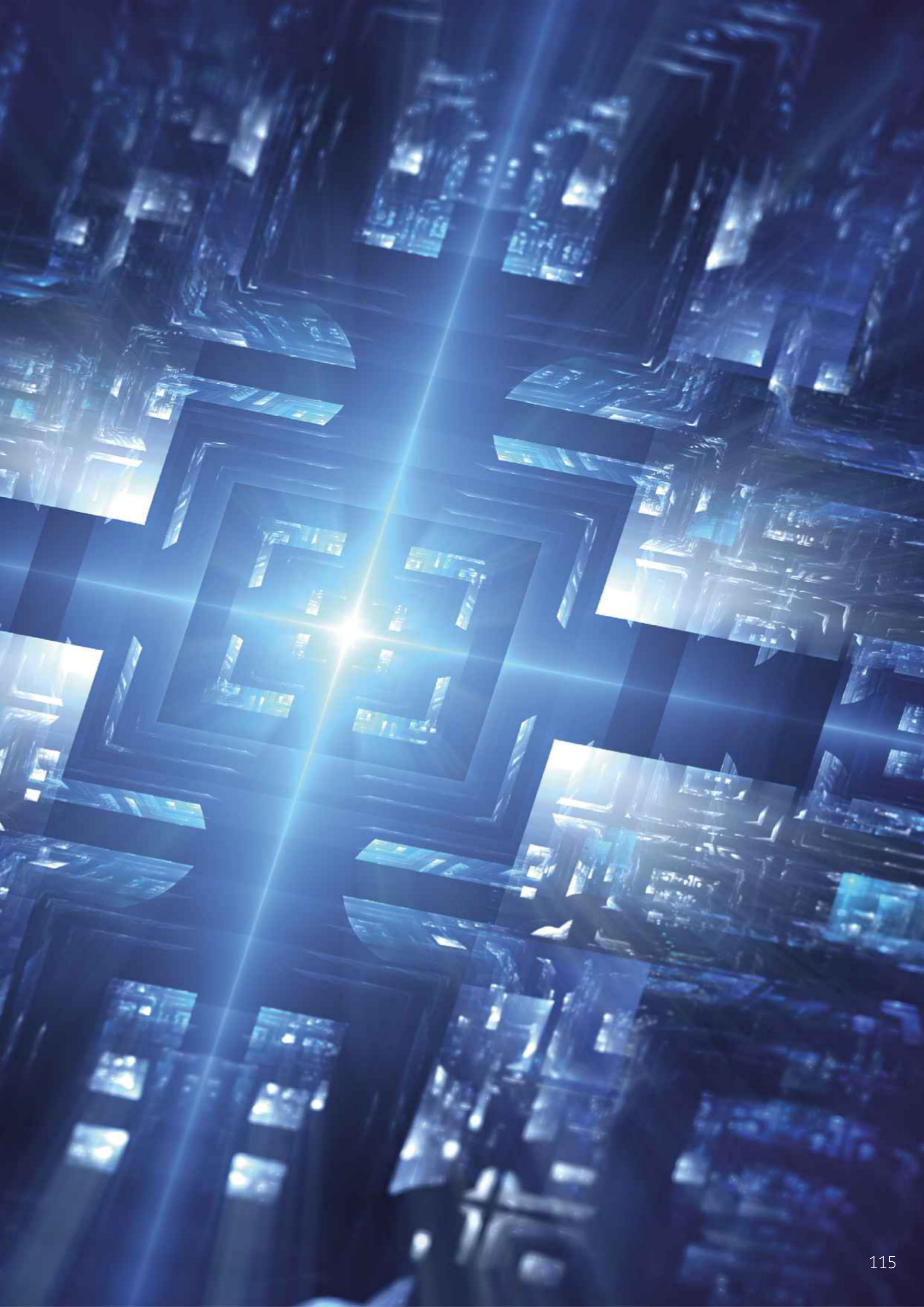
# QUANTUM CHALLENGE

**MIKE BEDFORD EXPLORES THE LATEST ADVANCES IN QUANTUM COMPUTING, AND HOW INTEL AND IBM ARE WORKING TO MAKE AN IMPACT IN THE REAL WORLD**

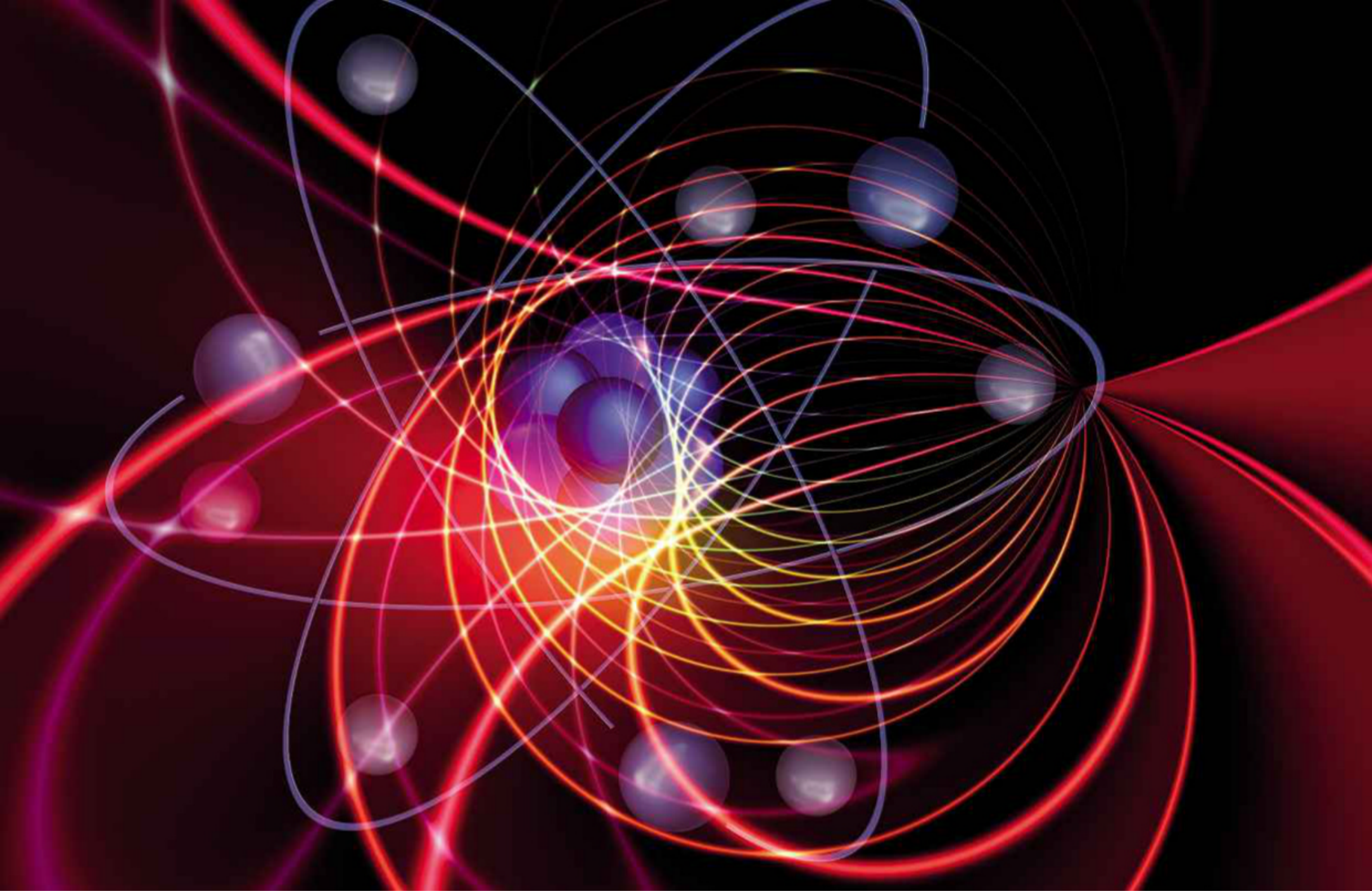
**I**n 1965, Intel co-founder Gordon Moore made a startling statement. Every year for the following decade, he suggested, the number of transistors on mainstream chips would double. Shortly after, he amended that predication to a doubling every two years, and remarkably his 10-year forecast has pretty much held true to the current day. This has provided us with huge increases in computing power, and no prospect of it ever coming to the end of the line. Until now, that is, because some experts believe Moore's Law has run its course, and that future developments will be much more modest.

This gloomy prediction relates to the 'business as usual' scenario of speed improvements coming from even more transistors, fuelled by a reduction in the chip's feature size. It's this shrinking of the on-chip transistors that seems to be stalling, but some experts are considering whether there are other ways to bring us back on course for the year-on-year improvements we've grown to expect. In particular, pundits suggest, the future of computing might be a multi-faceted one, with multiple technologies working hand in hand. ➔









One such technology – the futuristic sounding quantum computing, with its potential for almost unimaginable levels of performance – is our subject here.

## QUANTUM LEAPS

So how close are we to the current developments in quantum computing research starting to affect the real world? With several major players in computing involved, we might expect that quantum computing could soon come of age. But the reality is that it's still astonishing, unfathomable and downright weird technology.

It's hard to actually understand how quantum computing works, in the normal sense of the word; nobody does. Instead, you're going to have to take it on face value, even though it's totally counter-intuitive. Even the eminent Danish physicist Niels Bohr, one of the pioneers of quantum physics, admitted this.

"If you think you can talk about quantum theory without feeling dizzy, you haven't understood the first thing about it," he famously said.

Quantum physics is concerned with the behaviour of sub-atomic particles, in contrast to classical physics, which deals with larger objects. This is the primary reason

**ABOVE:** Sub-atomic particles might be hard to visualise, and they behave in totally bizarre ways, but their strange behaviour could unleash almost unimaginable computing power

**BELOW:** Even some of the best minds in physics, such as Niels Bohr (left) and Albert Einstein, had to admit that quantum behaviour is downright strange



that we're inclined to think of quantum behaviour as strange, bizarre and even downright impossible. After all, our common-sense view of the world has been conditioned from our observation of large objects. By way of contrast, we've never seen sub-atomic particles, and this explains why their behaviour, when it differs from that of everyday objects, appears totally unbelievable.

First up in our tour of quantum phenomena is the property known as superposition. To say that something can only be in one place at one time, or that an electronic circuit can only be in one state at once – for example, the on and off of a transistor that defines the states of 0 or 1 in a digital computer – might seem obvious. Once we get down to sub-atomic dimensions, however, this isn't guaranteed. Such particles can indeed be in two places at once or in

two states at once; this is called superposition. To make things even stranger, you can never observe a state of superposition because the very act of observing it causes the superposition to be destroyed – a process called decoherence. So, for example, if an electron is in a superposition of the two states known as spin-up and spin-down, as soon as you observe it, it

will decohere to reveal either the spin-up or the spin-down state at random.

Next we come to a property of two or more sub-atomic particles, which is called entanglement. If two particles are entangled, something that can be brought about by some sort of interaction between them, they share properties so that neither particle can be defined individually. Let's consider two superimposed electrons that are entangled so that they have opposite spins. Initially, both particles are in a state of superposition, having an up and a down spin simultaneously. We know that observing the spin of either electron will cause it to decohere and thereby reveal either an up or down spin. However, when we do observe one electron and, in so doing, cause it to decohere, the other particle will decohere at exactly the same moment and will exhibit the opposite spin. It was predicted by theory, and confirmed by experiment, that this takes place instantaneously, however far apart the two particles might be. Einstein called this "spooky action at a distance" because it seemed to contradict the laws of physics, which state that nothing can travel faster than the speed of light.

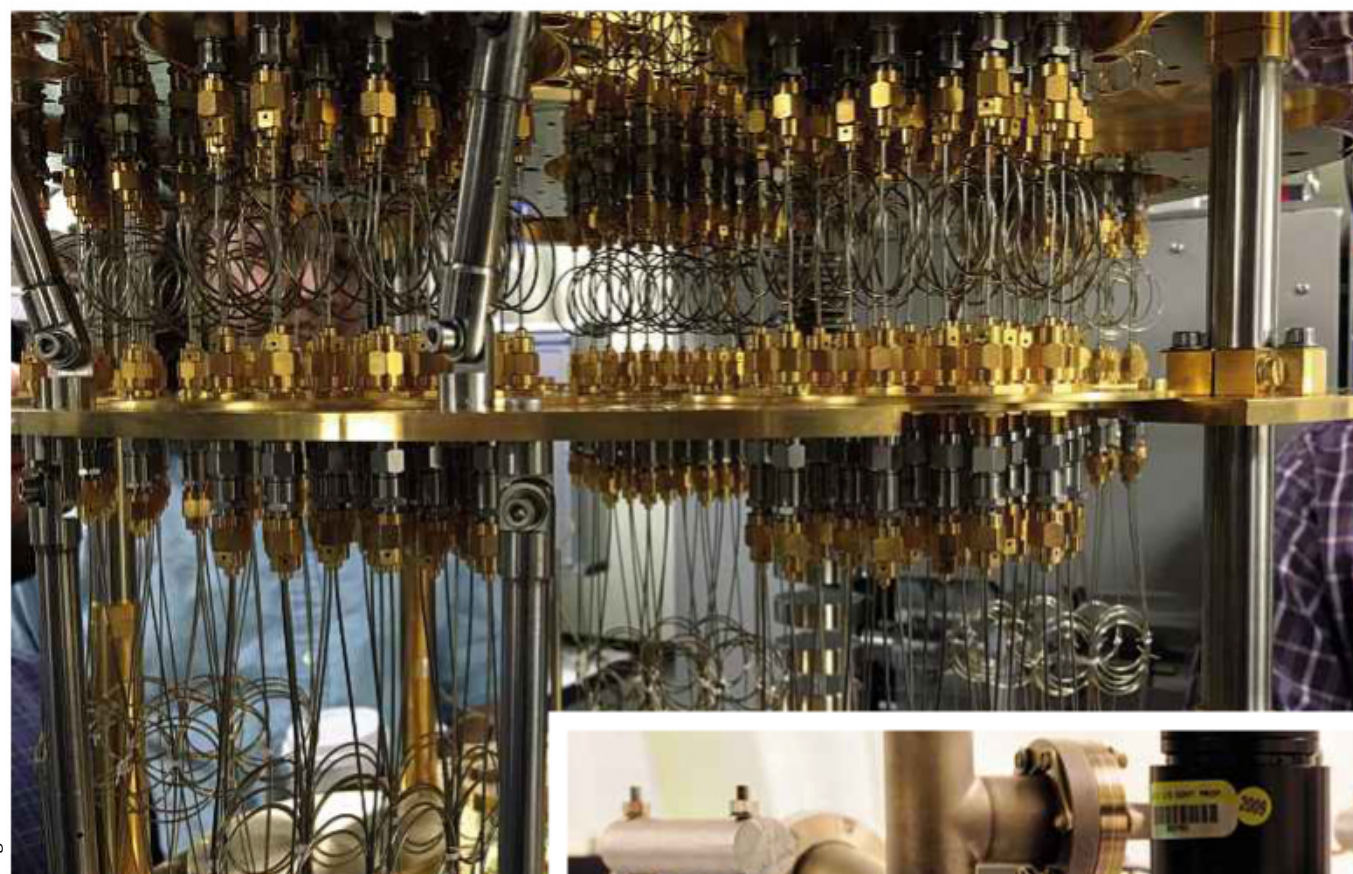
## THE QUANTUM EDGE

So we've seen something of the strangeness of quantum physics, but how does any of this relate to computing? In fact, we've already hinted



**UNIMAGINABLE  
POWER IS JUST  
A QUBIT AWAY.  
IF ONLY THINGS  
WERE THAT  
SIMPLE.**

Image: IBM Research



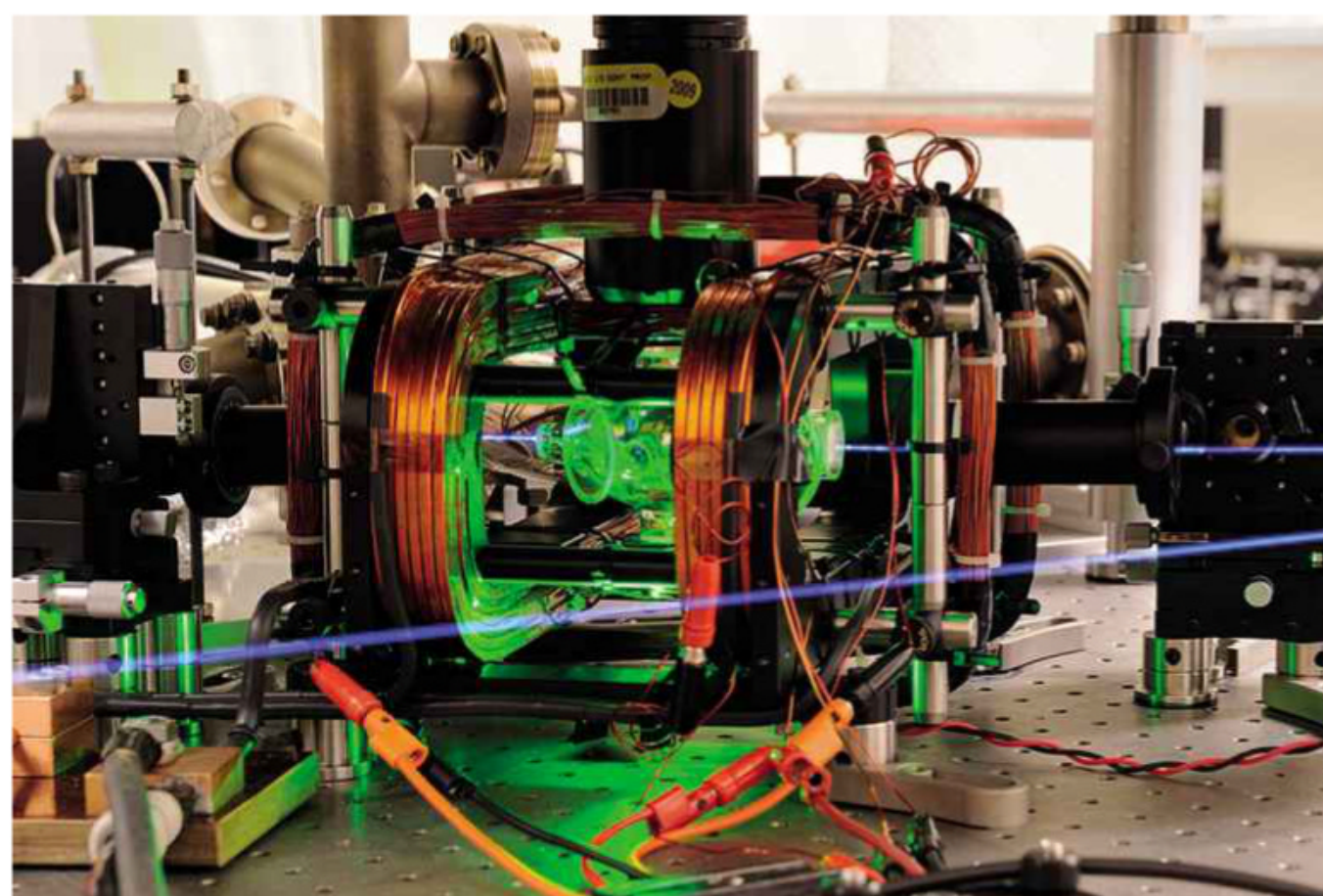
at this by referring to a transistor that can normally be on or off, representing 0 or 1 in a computer's binary language, and suggested that, once we get to sub-atomic particles, all this changes due to the possibility of superposition.

Certainly we could use a single electron as a computing bit, using the spin-up and spin-down states to represent 0 or 1, but it doesn't end there. If that electron was put into a state of superposition, it could represent both 0 and 1 at the same time. What's more, if an operation was carried out on that bit, the operation would work on its two values simultaneously. And it gets better as you add more bits, or qubits as we should call them, this being shorthand for quantum bit. If we have two qubits, they could hold the four values of 00, 01, 10 and 11 simultaneously, and moving forward, the number of superposed states doubles with every additional qubit. So an 8-qubit computer could operate on 256 bits values simultaneously and, by the time we get to the equivalent of today's 64-bit architecture, which would be 64 qubits in the quantum world, a vast 18,446,744,073,709,551,616 operations could take place at the same time. How about that for parallelism?

With conventional computers, to double the performance you need twice as much hardware; with a quantum computer you only need to add a single qubit. Unimaginable power is just a qubit away. If only things were that simple.

## THE STATE OF PLAY

A review of companies researching quantum computing reveals big players including Google, plus several other



**TOP:** Gold-coloured coaxial cables are used to send inputs and outputs from inside the dilution refrigerator, which is needed to keep IBM's quantum chip colder than outer space

**ABOVE:** Microwave apparatus used in a quantum computing experiment at the National Institute of Standards and Technology

companies who, as yet, are largely unknown to the layperson. It's interesting to note, however, that Microsoft, Intel and IBM – the three companies who, arguably, were the most influential in the birth of the personal computing revolution – all have active quantum computing research projects. This begs the question of whether history is about to repeat itself, so we were eager to learn about their work in the quantum realm and their predictions for the future. We spoke to Intel and IBM to find out about their progress to date, the challenges and their future plans for this embryonic technology.

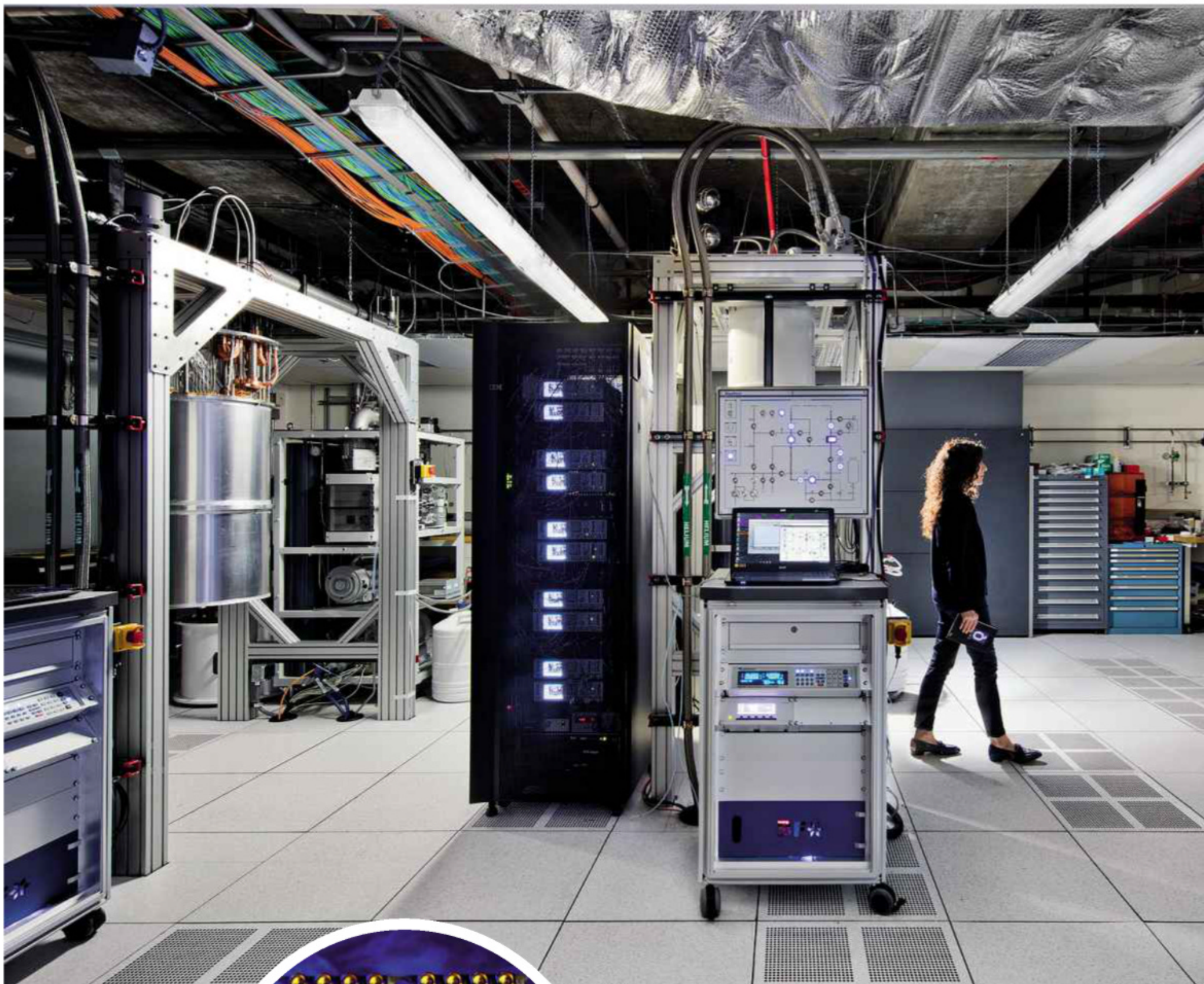
A quick survey of milestones in quantum computing research reveals one key metric: the number of qubits that have been implemented in a single device. And progress seems to have been slow, much slower than the increase in the number of bits in the early days of the microprocessor.

The first demonstration of a quantum computation, in 1998, had just two qubits, and it took 19 years for this to equal the 16 bits of the Intel 8088 processor that was used in the first IBM PC. So is the quest for qubits the main difficulty in bringing us a workable quantum computer and, if so, why is progress so slow?

Dr Stefan Filipp, quantum research technical lead at IBM Research in Zurich, explains: "Actually, the number of qubits is only part of the story. If we want to use quantum computers to solve real problems, the number of qubits is important, but so is the error rate. In practical devices, the effective error rate depends on the accuracy of each operation as well as how the processor performs the operations, and also on how many operations it takes to solve a particular problem."

While again not dismissing the need for qubits, Jim Clark, Intel's director of quantum hardware, also referred to the

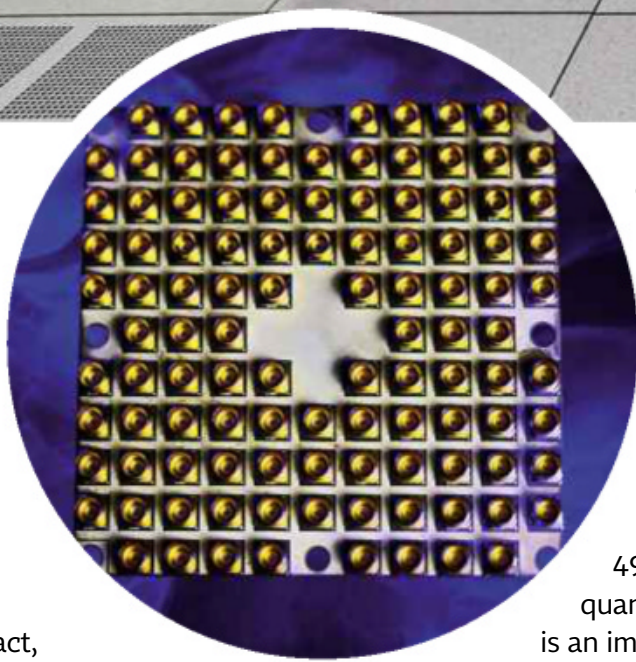




broader picture and, in particular, the supporting structure that will be needed once sufficient qubits become available.

Clark explains: "The quest for qubits enables Intel to advance its research across the complete quantum computing stack, including its architecture, algorithms and control electronics. In fact, the Intel Labs team leveraged a simulation of a many-qubit quantum computer, operating with the full stack to inform decisions around the design of this device's enhanced control electronics for the quantum computing system. This will better enable us to deliver a large-scale, universal quantum computer."

So while the quest for a real-world universal quantum computing



**ABOVE:** Intel now has a 49-qubit chip, a similar figure to several other researchers

evidently faces a range of challenges, we can't get away from the fact that the qubit count is vital. Most of the major players are at a similar level of development, according to Clark.

"This January, Intel unveiled Tangle Lake, a 49-qubit superconducting quantum test chip. Tangle Lake is an important milestone because it will allow researchers to assess and improve error correction techniques and simulate computational problems."

Filipp confirmed the view that many companies are at around the 50-qubit point by reference to IBM's latest and greatest.

"In November 2017, our first IBM Q systems were made available online to clients with a 20-qubit processor, featuring improvements in

**ABOVE:** The IBM Q computation houses IBM's most advanced quantum computers, accessed via IBM Cloud

superconducting qubit design, connectivity and packaging. The coherence times lead the field with an average value of 90 microseconds, whereas qubit operations can be performed in about 100 nanoseconds. This is enough time to entangle the qubits and maintain their superposition to carry out first algorithms.

"We also successfully built and measured an operational prototype 50-qubit processor with similar performance metrics," he says.

## BIT PART

We might now have a feel for the state of the art, but we were keen to understand better what these companies really mean when they refer to a 50-qubit chip. After all, while





Image: D-Wave Systems

## THE D-WAVE COMPUTER

While researchers in academia were just starting to demonstrate quantum computers with double-digit numbers of qubits back in 2011, Canadian company D-Wave announced the world's first ever commercial quantum computer, the D-Wave One. It had 128 qubits.

Experts continue to be divided on whether this machine or its successors, including the company's latest – the 2,048 qubit D-Wave 2000Q – are genuinely quantum computers. However, D-Wave drew our attention to papers in two prestigious peer-reviewed academic journals that describe the architecture as employing quantum effects.

D-Wave says it still has work to do to reach benchmarked quantum advantage – by which it means obtaining proof that the architecture achieves a speed advantage over a conventional computer – and it says it will be an important milestone when it, or anyone else, does.

A key factor to recognise when considering D-Wave's 2,048 qubits compared to around 50 elsewhere is that we're not comparing like with like. The quantum computers discussed in the main part of this article are general

purpose, in the same way that today's PCs are general purpose. By way of contrast, D-Wave says that its machines employ the technique of quantum annealing, which is dedicated to certain types of problems. Included here are optimisation, machine learning and image analysis, with applications in areas such as logistics, artificial intelligence, materials sciences, drug discovery, cyber security, fault detection and financial modelling.

Three organisations that apparently do believe in the potential of this approach are NASA, Google and the Universities Space Research Association, which in 2013 jointly invested in a 512-qubit D-Wave Two. This has since been upgraded to 2,048 qubits.

NASA says it's using this system to investigate areas where quantum algorithms might someday dramatically improve the agency's ability to solve difficult optimisation problems in aeronautics, earth and space sciences, and space exploration. It goes on to refer to the key areas where this type of machine can excel, namely machine learning, optimisation and pattern recognition.

today's mainstream microprocessors might have a 64-bit architecture, they contain many more than 64 binary bits when all the internal registers are taken into account. We asked Filipp whether that 50-qubit figure relates to the width of a register or the total number of qubits, or something entirely different. Interestingly, his response suggested that the concept of a register doesn't apply to quantum computers.

"For a quantum computer we do not talk about registers but about the total number of quantum bits," Filipp explains.

"Each qubit has to be connected to at least one other qubit so that, by applying quantum gates acting on single or two qubits, one can create entanglement. This entanglement can spread over all qubits. Moreover, things are a bit more complicated when we start talking about quantum error correction. Since the qubits are not

perfect and will not be, because of their interaction with the environment, a universal quantum computer – the ultimate goal in the field – will have to rely on error-correction schemes. For these error-correction schemes one needs to encode each logical, error-corrected qubit into many physical noisy, imperfect qubits with typical numbers of 1,000 and more physical qubits needed to get one logical qubit."

### THE WAY AHEAD

The reference to needing 1,000 physical qubits to implement a single logical qubit, and the fact that the coherence time of IBM's qubits is just 90 microseconds, is quite an eye opener. It's quite different from what we're used to in today's computers, where bits remain in the state they are set. Clark notes that "qubits are tremendously fragile", by which he means that they easily lose that state of superposition.

**TOP:** The D-Wave 2000Q has 2,048 qubits, far more than researchers at Intel or IBM have achieved, but it uses a different architecture for optimisation problems

We've seen that deliberately observing a qubit causes it to decohere, but it transpires that this is just the tip of the iceberg.

"Any radio frequency noise or unintended observation of them can cause data loss," Clark explains. His coin analogy – in which a spinning coin represents a state of superposition, heads and tails simultaneously – helps explain this, and also why the problem increases with the number of qubits.

"Consider a handful of coins," he says. "Imagine you and three or four friends are trying to get as many coins as possible spinning on a tabletop without any falling over. The longest you would likely get a quarter to spin is about eight seconds. Say you get another coin spinning every second, the most coins you could have spinning simultaneously would be seven coins, and that seven-coin 'system' would only be active for one second in total before



at least one of the coins wobbled and fell to the table. Even if we somehow managed to get 300 coins spinning on a tabletop at the same time, the slightest bump of the table would cause all of the coins to collapse. This is the challenge of radio frequency noise in a quantum system. To eliminate noise, qubits must operate at a temperature of approximately 20 millikelvin, 250 times colder than deep space.”

All of this begs the question of how close we are to a practical quantum computer. Clark’s analysis isn’t too encouraging.

“When it comes to developing a commercially relevant quantum computer, we’re at mile one of a marathon,” he suggested, before referring to a possible target.

“Commercially viable systems will require tens of thousands or close to one million entangled qubits.”

## WAY TO GO

Meanwhile, Filipp’s views on how many qubits are needed in a real-world quantum computer, compared to today’s 50, seem to support Clark’s view that there’s a long way to go, albeit not quite as far as Intel’s prediction.

“We have already implemented a new quantum algorithm capable of efficiently computing the lowest energy state of small molecules,” Filipp says.

“More recently, our team in Zurich has published a quantum algorithm that analyses risk more efficiently than Monte Carlo simulations traditionally used on classical computers, which has implications for financial risk analysis. To achieve more complex applications, we will need to reach a few hundreds of qubits.”

We might only be a mile into a marathon, and today’s 50 qubits might

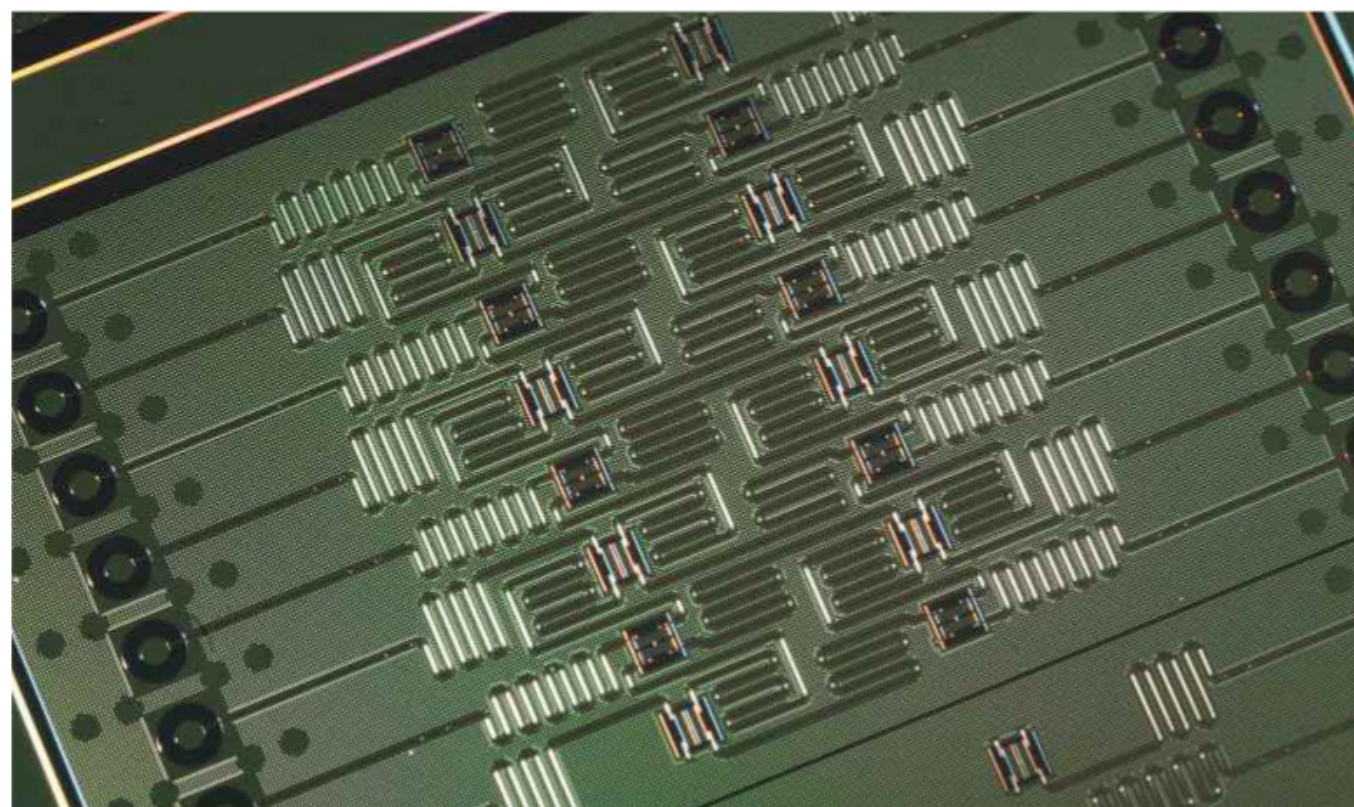


Image: IBM Research

**ABOVE:** So far there’s been no consensus on the best way to build a quantum-computing chip. IBM’s approach involves superconducting circuits

look rather puny compared to the hundreds, hundreds of thousands, or million qubits that we might need, but what does that mean in terms of time? IBM believes we’ll get there in the next few years, although Intel pictures us currently being where we were with classical computers back in the 1970s.

“In almost every way, the outlook for quantum mirrors the development of supercomputers 40 years ago,” Clark says.

“The introduction of the Cray 1 in 1975 marked the most advanced commercial computational system ever available. Every national lab in the country bid to be the first to receive the machine.


“But today, the smartphone in your back pocket has more computing power than researchers could have ever dreamed of fitting into that 5.5-ton device. Today, the outlook for quantum is big, bulky, cold and complex. But in the near future, they could provide exponential computing power to every technology-driven task we can

dream up, first in research, like in national labs, then in business.”

But who’s going to benefit? Are there really multitudinous applications for quantum computers? After all, what we mostly seem to hear about is Shor’s algorithm for factoring large numbers. Filipp begs to differ.

“An increasing list of applications can be found at [quantumalgorithmzoo.org](http://quantumalgorithmzoo.org), and these can be applied to problems ranging from quantum chemistry applications to tasks in machine learning,” he suggests.

“We are exploring how these can be applied to real-life situations. We have clients in the automotive industry, including Daimler and Honda, and in finance such as JPMC and Barclays.”

Given such a broad range of applications, it seems barely conceivable that the quantum computer will be a technology looking for an application. Indeed, we can imagine the next generation questioning how we ever lived without it. 

## QUANTUM CRYPTOGRAPHY

One of the best-known algorithms that could take advantage of a quantum computer is Shor’s algorithm. While factoring a number using a conventional computer is essentially a trial and error approach, Shor’s algorithm would make light work of it.

This might be a curiosity to mathematicians, but the impact could be far reaching. The most commonly used forms of encryption rely on the fact that factoring a large number would keep the fastest computers busy for decades. But if practical general-purpose quantum computing were a reality, cracking encoded messages would be much more achievable.

Quantum technology might render today’s encryption technologies obsolete, therefore, but it could also offer an alternative, which is mathematically proven to be 100% effective. Enter quantum encryption.

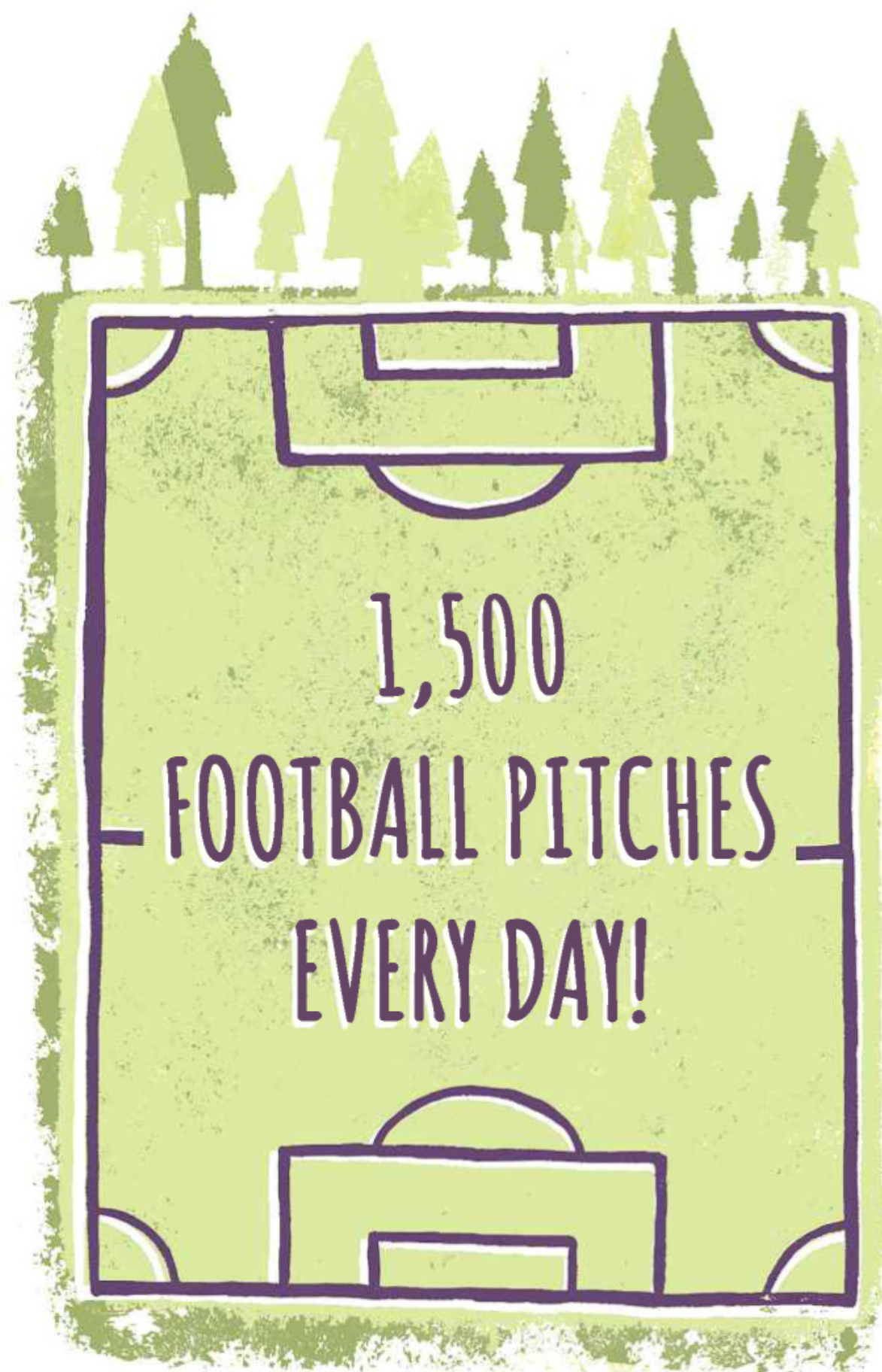


Strictly speaking, this isn’t a form of cryptography so much as a method of distributing a cryptographic key. Any encrypted message is totally secure if the key is the same length as the message and is never reused, but this has generally been considered impractical because of the difficulty in one party securely transferring the key to another. However, the quantum approach allows two parties to share a key

using a strange quantum effect that tips off the communicating parties if an eavesdropper has intercepted the key.

Unlike the general-purpose quantum computer, which is probably at least a decade away, quantum cryptography is with us today. While any government and military systems are likely to be shrouded in mystery, it’s interesting to note that several companies already offer commercial quantum key distribution systems.





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# Money for old rope?

As video-game publishers keep a tighter rein on their older titles and take action against illegal download sites, can a new 'Netflix for games' help bring retro gaming to a wider audience? **David Crookes** takes a look

**T**ype 'abandonware' into your preferred search engine and you'll find websites chock-full of old games from the 1980s and 1990s. They claim the titles have long been cast aside by their developers and publishers in favour of seemingly more sophisticated offerings. What's more, many reckon you're entirely free to download them.

In truth, most of those games are still under copyright, with one particular site including Pac-Man, Tetris and Lemmings, which are still active franchises. But it has to be said that software companies have perhaps been a little too quick in the past to treat their past games as throwaway commodities with, you may suspect, more than a hint of regret.

Codemasters, for instance, let players download *Treasure Island Dizzy* for free in 2005, while Revolution Software allowed *Beneath a Steel Sky* to be released as freeware

in 2003. Cinemaware also put its action adventure game Rocket Ranger out in the wild following its original 1988 commercial release, and those are just a handful of examples.

And yet newly found versions of Dizzy have been placed on cartridge and snapped up by eager fans, Beneath a Steel Sky was released as a remastered paid-for version on iOS six years later when it became clear there was still some life in the game, and plans for a remake of Rocket Ranger were launched on Kickstarter (albeit cancelled a year later).

➔ Steve Cottam says  
Antstream began to take  
shape four years ago when it  
received investment

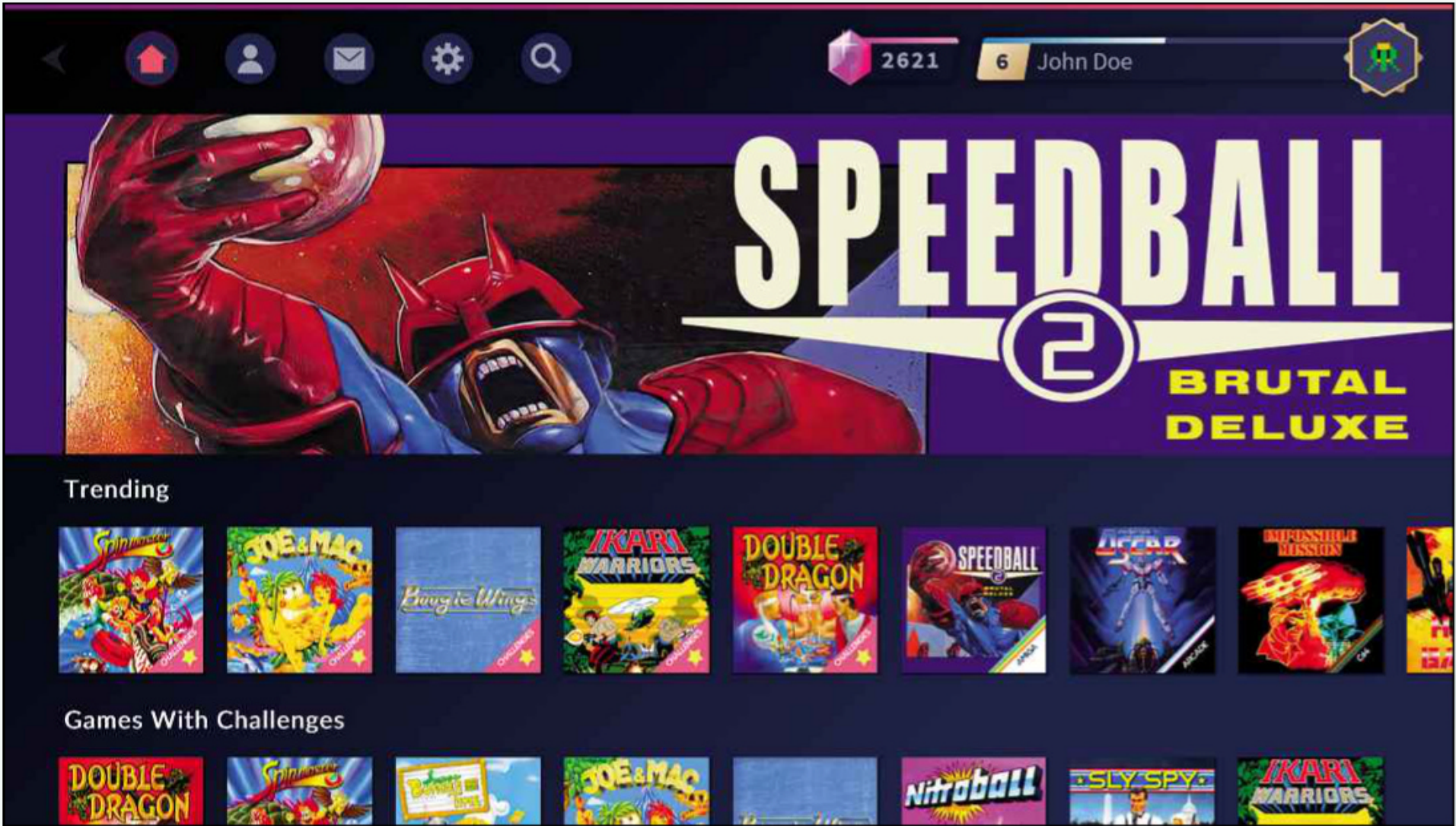
Today, understanding the ongoing clamour to play retro titles, publishers and developers are more switched on to the potential of their old games, and the trend now is to make it easier for gamers to enjoy them without having to fiddle around with emulators or blow into dusty carts to get them working

on the original machines –  
assuming, of course, that  
you still have them.

To that end, a new service called Antstream is hoping to make a big impact. It dubs itself 'Netflix for games', since it allows players to take out a subscription and stream scores of retro titles to multiple devices. The company has taken to







Kickstarter to raise funds and it claims to have more than 2,000 games already licensed.

For CEO Steve Cottam, it's the realisation of a long-held idea. "I wrote the first line of code for Antstream about 10 years ago when it was a hobbyist project and, like many enthusiast projects, we formed a small team working tirelessly and unpaid for several years, sacrificing evenings and weekends with friends and family to get the project off the ground," he tells us.

Cottam certainly has fine retro credentials, teaching himself Z80 coding on the MSX and moving on to the Amiga, before developing and publishing an eight-player PC game called Nitro Racers in 1994. He says he had the idea for the company when he visited gaming

Just like Netflix, the homepage highlights genres and groups games by those that are trending or have special attributes

conventions and saw how gamers would flock around retro arcade cabinets such as Pong.

"My motivation is to have these iconic games as accessible as possible so that new audiences can enjoy them," Cottam says.

"I want playing a game on Antstream Arcade to be as easy as watching Netflix or listening to Spotify."

ANT AND SPECS

Antstream became a company in 2014 and, for the past five years, the team – which now numbers 20 – has been itching to perfect the

system, which is finally ready to be launched. Lending credence is Ian Livingstone, who was the co-founder of the *Fighting Fantasy* game books and the 'father' of *Tomb Raider's* Lara Croft, thanks to his 20-year involvement with publisher Eidos Interactive. Livingstone is Antstream's chairman, while the founder of TT Games, Jon Burton, is creative director and the co-founder of Playdemic, Darren Melbourne, is the firm's licensing director.

Some of the team have also written emulators for the Spectrum and BBC Micro, created arcade versions of games such as *Midnight Resistance* and even bagged a Guinness World Record (an accolade that goes to Jim Bagley, who used 15,824,610 bytes to recreate *Dragon's Lair* in 2015, making it the largest video game ported to the ZX81).

"Everyone we employ is a retro game enthusiast first and foremost," Cottam says. And yet Antstream can be cagey when it comes to some of the finer details of the system itself.

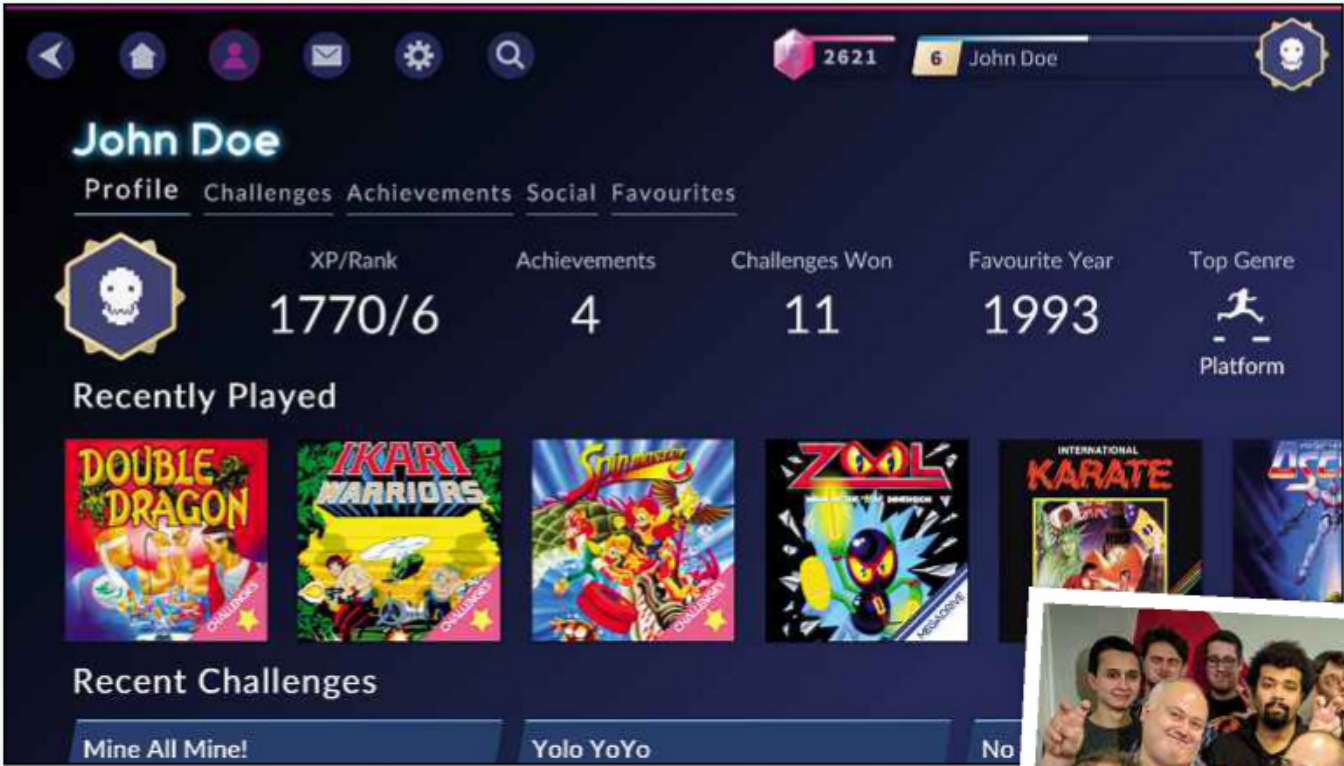
Although Cottam says the service will allow gamers to play titles originally made for the Spectrum, Commodore 64, MSX, BBC Micro, Amiga, Mega Drive and more, he adds, "I can't share details on emulation due to NDAs [non-disclosure agreements]."

There have also been questions regarding lag – the delay between a player pressing a button and the game reacting to it – but while Cottam says "reducing lag is very important" and adds "our streaming tech is very well optimised for retro games", he won't divulge the ins and out of the technology being used. "I can't go into our secret sauce," he says.



There are loads of classic retro titles, including *Ikari Warriors*, and as well as arcade versions, there are those created for home computers and consoles





◆ Profile pages list ranks, achievements, challenges, and even a player’s preferred genre and favourite year

Games, Gods, The Last Ninja and Double Dragon, among a host of other recognisable names. To secure these, Melbourne has had to turn detective and scour the world for the people who own the rights. Given so many game companies have been bought and sold, and huge numbers have gone bust, it has often entailed days of work for a single title.

“Tracking down the rights is a crucial part of what we do; it has taken many years and a lot of hard work,” Cottam tells us. Once tracked down, however, rights holders tend to want to become involved.

“I can tell you that the idea is universally well received,” Cottam says.

“We offer a lot of value to content owners

and we work really hard to make it easy for them to work with us. Also, where licences permit, we try to cover as many original formats as possible. For gamers looking for a nostalgic hit, we want to help them recover their gaming memories.”

That means players may be able to choose which format they want to play a particular game in, perhaps deciding between the ZX Spectrum and Commodore 64 so as to avoid

Even so, he does reveal that Antstream has worked with “the leading data centre providers to ensure we can put the games as close to the gamers as possible”, and says a lot of people will be surprised by how quickly the games react despite being streamed online rather than downloaded and installed.

“Latency is something we have worked exceptionally hard on,” he continues and, to be fair, revealing to the world just how the company has managed to pull it off is only going to reduce its competitive advantage in an industry that is fast turning to streaming.

Indeed, it won’t be long before Google launches its own cloud gaming service, Stadia, which will be playable via its Google Chrome browser (see ‘The Lowdown’, *Shopper 377*). Sony already has PlayStation Now, and

◆ Steve Cottam (centre) has been working on Antstream for more than 10 years

Microsoft’s Xbox Game Pass has been a big success. However, by having lots of licensed retro titles for some of the most popular 8-bit and 16-bit home computers and consoles, Antstream has a unique selling point, even though it knows it can’t rest on its laurels (or spill that sauce).

**BUILDING A NEST**

Certainly, the roster of games it has so far is mightily impressive. There’s Speedball 2: Brutal Deluxe, Impossible Mission, California



**news**

● **NINTENDO ORDERS TAKEDOWN OF A MARIO PORT**

It took modder ZeroPaige seven years to create his highly impressive port of Super Mario Bros on the Commodore 64, but it didn’t take nearly as long for



Nintendo to spot the game and file a DMCA takedown notice.

Even though the game was technically superb – it had full side-screen scrolling and managed to run fast despite the C64’s clock speed being just over half that of the NES – Nintendo simply saw it as a violation of its intellectual property.

So, four days after it was hosted on the Commodore Computer Club’s website, it was ordered to be removed. This was no great surprise to seasoned retro watchers, since Nintendo is known to protect its games rigorously.

Last year, it filed lawsuits against websites accused of distributing illegal ROMs, which prompted the sites to remove the copyright infringing material.

You can, however, at least see how great ZeroPaige’s Super Mario Bros port looked and sounded by going to [tinyurl.com/378retro1](http://tinyurl.com/378retro1).

● **AMIGA 1200 EXTERNAL CD DRIVE SHOWCASED**

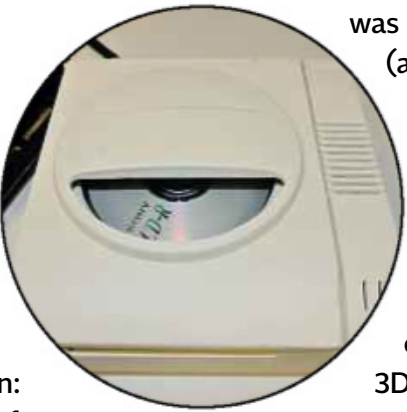
At a small gathering of the Amiga Retro Brisbane group in Australia, a developer called Marc G Falconer revealed an intriguing project he’s been working on: an external CD drive for the Amiga 1200.

It’s a fan-made version of the Commodore CD1200, a CD-ROM drive for the Amiga A1200 which,

as well as being unveiled at the CeBIT 94 show, was included almost as an afterthought at the European Computer Trade Show in April 1994.

The expectation was that it would put the Amiga ahead of its competitors, but while it was never released (and the A1200 was discontinued in 1996), seeing a new external drive working via IDE and sitting in a custom-designed 3D-printed case that resembles the original is nevertheless satisfying.

Falconer says the innards are from a standard laptop drive and he wants to run it with a CD32





➔ Challenges are issued for the games to allow players to compete against one another and give them another reason to play

the playground wars of old. One platform that is unlikely to appear any time soon, however, is Nintendo. The Japanese publisher has long been protective over where its games appear and it has done a sterling job in placing them on as many of its own platforms as possible, making ever more money from its old games.

Nintendo guards its IP so closely that it even recently filed a takedown notice against a modder who spent seven years porting Super Mario Bros to a Commodore 64 (see 'News', below). But with so many other platforms and titles to go at, that shouldn't pose a problem for most gamers or, indeed, for Antstream.

Cottam notes, "Antstream is all about the challenge. We work hard to make the games more engaging through unique multiplayer challenges. It's a much more social experience."

### CREATING A COLONY

Certainly 'social' is an aspect of the service that Antstream is keen to promote. It will allow gamers to try to get a high score in a game or challenge players to complete a boss rush and show off their achievement to others. It's a way of re-creating the feel of an arcade at home and, while it's been used by others in the past, notably Nintendo with the NES Remix, it will give a fresh spin to those old classics.



"We wanted something that represents community, collaboration and strength," Cottam says.

"The challenges really make Antstream stand out as we work hard to make it a much more social and engaging experience."

One of the benefits of such a move is being able to potentially widen the appeal of the service away from the hardcore retro gaming community.

"Nostalgia plays a big part in keeping retro popular, but we are seeing a lot of younger players enjoying retro games," Cottam explains.

"There is also a certain kind of cool from playing the games that are the foundation of everything we play today."

Even so, Antstream may eventually seek original, exclusive non-retro content as time goes by, particularly if publishers 'do a Disney' and decide to go it alone in the future (Disney has pulled its content from Netflix in order to set up its own streaming service, called Disney+).

For now, however, it's about looking back and enjoying the games of yesteryear while keeping one eye on the present and another on the future.

"We offer a lot of value to content owners, and we work really hard to make it easy for them to work with us," Cottam says.

Antstream will be available on Windows, Xbox, Android, Amazon Fire TV and Mac, with an iOS version pending Apple's approval. 📺

emulator. Whether or not he decides to create units for others remains to be seen, but lots of Amiga fans would undoubtedly love one.

### CONNECT A SPECTRUM TO A VGA MONITOR

As we continue to wait for the release of the ZX Spectrum Next ([www.specnext.com](http://www.specnext.com)), it's good to see some new hardware for the original Speccy.



Created by Goran Radan, ZX VGA Joy lets you connect the 8-bit computer to any CRT or LCD VGA monitor and, while it's a sizable add-on, it supports seven screen modes, boasts a Kempston joystick interface and has a reset button, too.

Radan says it's not a signal convertor, rather it takes video data directly from the CPU to provide clear pictures. It also works with any Spectrum model, which means you can pop it into the back of a Sinclair or Amstrad version without any modification.

Find out more by going to [zx-vga-joy.com](http://zx-vga-joy.com), from where you'll be able to buy a unit that's shipped from Germany. Depending on the postage option you choose, it will set you back around €70 (£60).

### 16-BIT PROGRAMMING LANGUAGE SET FOR RETURN

In late 1988, developers François Lionet and Constantin Sotiropoulos worked on a programming language for the Atari ST called STOS BASIC for Mandarin Software. They followed it up a couple of years later with AMOS for the Amiga.

Both were popular with developers and helped the public domain and shareware scenes for the computers to flourish. Now Lionet has been working on AMOS 2 for modern machines,

and it comes with a bonus for anyone who worked on an original project.

As well as planning a modern AMOS 3D with WebGL, Lionet says the software will understand past programs written in AMOS and allow developers to republish them,

which is sure to bring fresh life to past gems (as well as some terrible stuff, we'd imagine).

"They will work everywhere on everything thanks to the magic of JavaScript and HTML5," Lionet writes in a Patreon post that aims to raise money for the project ([tinyurl.com/378retro2](https://tinyurl.com/378retro2)).





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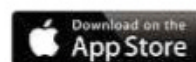
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# Helpfile & Business Help

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## Drive! Drive!

I've been using Google Drive for ages, and it now contains several years' worth of personal and household files. A while ago I started my own business and followed an ancient *Shopper* guide (*Business Expert, Shopper 297-299*) to setting up Google Apps (now G Suite). From that point, I should probably have started saving work files in the Drive that belongs to my work account, but I didn't.

The result is that although I have a Google account linked to my work email address, my work files are stored in my personal Google Drive. When I want to share a file or collaborate on clients' documents, I have to use my personal Gmail address.

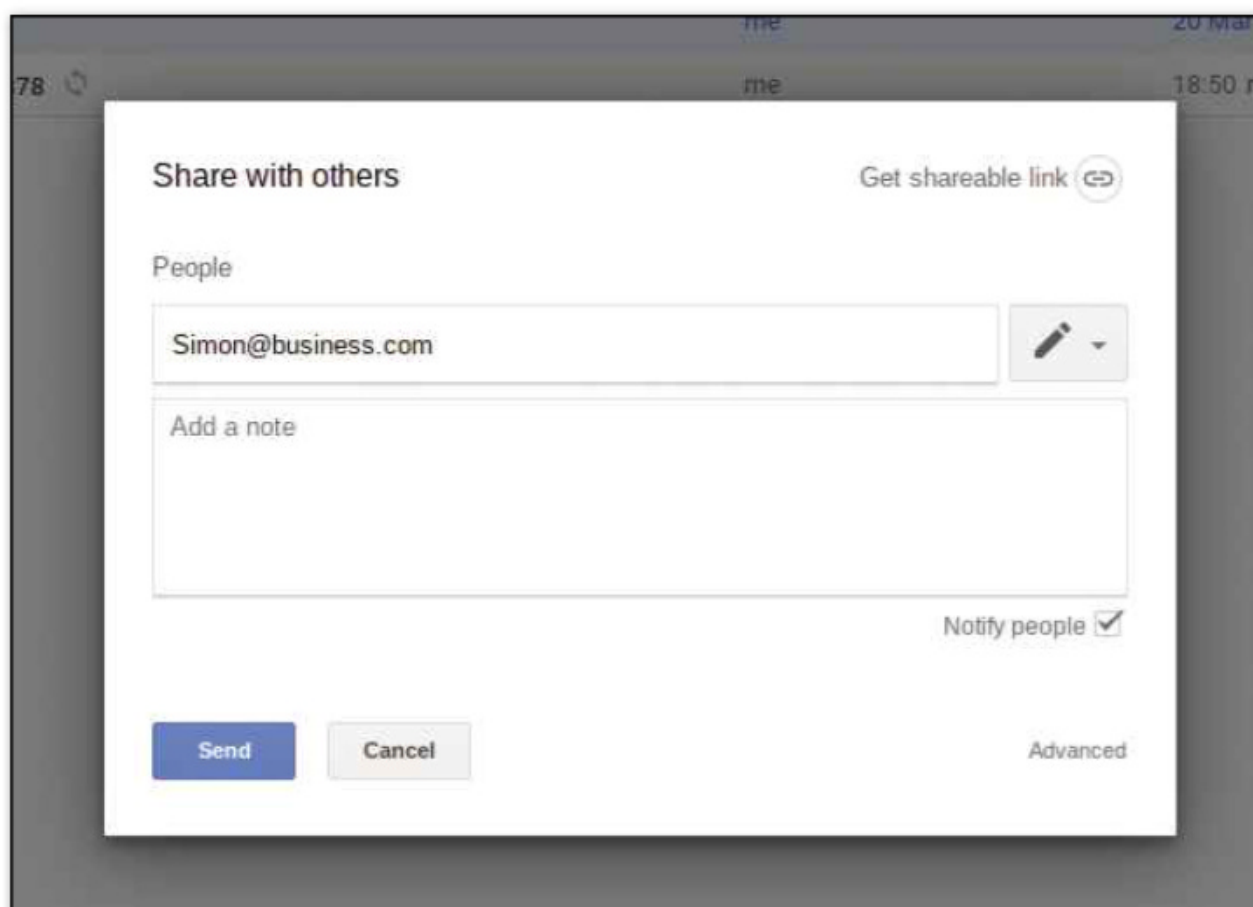
This looks unprofessional and has caused some confusion, so I decided to move my work files across to my work Drive. Unfortunately, copying the files keeps failing with various issues. Is it even possible to do this?

Ron Hawkes

Unfortunately, the short answer is no. Google won't let you directly copy the contents of one Drive to another, and while there are third-party apps and Chrome plug-ins that claim to do it, we haven't tested any of them enough to trust them with valuable and sensitive files.

The most reliable workaround would be to share your work files from your personal account to your work account, without actually moving them. Visit [drive.google.com](https://drive.google.com) and log in using your personal account, then right-click a top-level work folder (for example, work or clients), select Share, then invite your work email address, untick Notify people and click Done.

Now click your account picture in the top right corner and either select and sign into your work account if it appears, or click Add account and sign in that way. You'll now have a second Drive tab open, showing the contents of your work account. Click Shared with me in the left-hand pane and you should



↑ You can't copy the contents of one Google Drive to another, but you can share them, and in some cases transfer ownership

see the folder you just shared; right-click it, select Add to My Drive and the folder will appear in the top level of your work Drive. Repeat the process for any other work folders until all of your work folders appear, and organise them as necessary.

This gives you access from your work account to your existing files and folders, but there are some issues and limitations. Because your personal address (@gmail.com) and work address (@business.com) aren't on the same domain, you can't transfer ownership of the files to your work account. You can remove them from your personal Drive so they're no longer shown, but they'll still be counted against your personal storage allowance, and they'll be lost if you ever close your personal account.

If you continue working within the shared folders from your business account, any new files will be counted against your

work account's storage allowance, but they'll still be shared to your personal address. That might not be a problem, other than the fact that you'll see lots of sharing reminders when creating files. To prevent this, you could either manually change the permissions on new folders as you create them, preventing them and their contents being shared, or you could treat your existing shared work folders as an archive and begin a new folder structure within your work Drive.

One final issue is where clients have shared documents to your personal account and you've organised them into your own work folders. Provided you have edit permission, these docs will be shared to your work account along with your own files. If you've only got viewing or commenting access, you should seek edit permission first, or simply ask your client to grant edit permissions to your work address.



# How safe is safer?

Your ‘Beat the Hackers’ feature (*Shopper 371*) was very helpful, but it raised some concerns. While I’ll change my Amazon password pronto, I won’t follow your advice to confirm its strength by showing it to Password Meter. How strong is Password Meter’s own security, I wonder? I’d ask the same question about LastPass, which you recommended we use to store passwords.

I have one other question relating to the feature: if I do a factory reset on my phone before trading it in, has my stored data been thoroughly wiped, or could someone with the right know-how and hardware still get access to it?

Alan Thomas

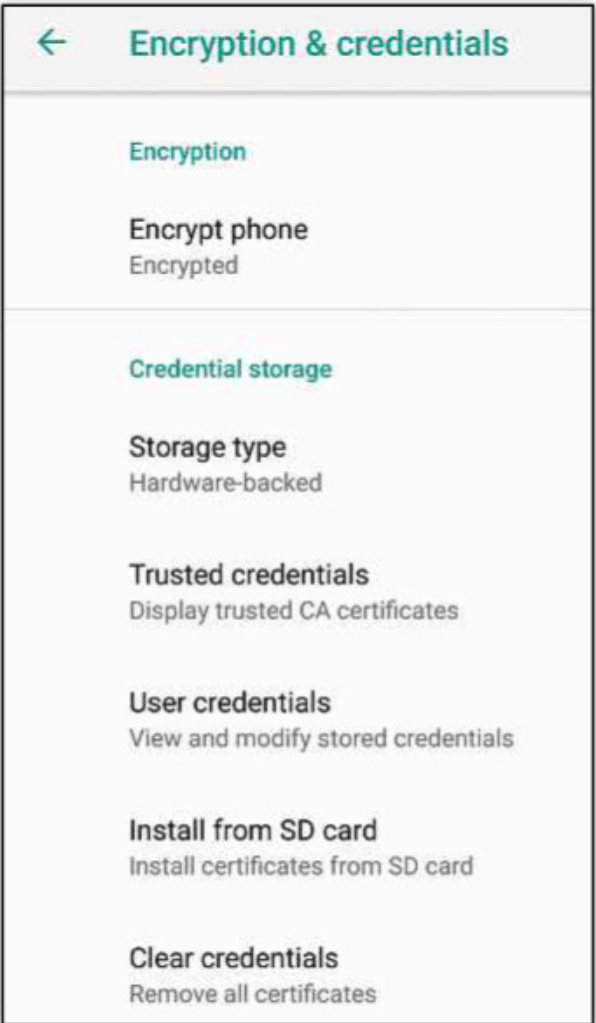
Many web-hosted password-strength meters use jQuery, a JavaScript library that operates within the browser. A legitimate password strength meter won’t send the password to the internet, but you can help ensure this by loading the meter from within an incognito or private browsing session (so the page can’t save cookies), disconnecting your computer from the internet by pulling out its Ethernet cable or disabling the wireless connection, and only then testing your password(s). Close the password meter before reconnecting the computer to the internet.

LastPass is a different proposition, as its core functionality includes synchronising and

sharing passwords between devices over the cloud. To achieve this safely, the app encrypts all passwords and other sensitive information on the device, and only synchronises encrypted data. As the password is never transmitted, and the keys used to encrypt and decrypt information are never sent to LastPass, the company itself has no access to your data. Or that’s the theory: while we’ve no reason to doubt LastPass, we only have its word for this. As its software is proprietary, rather than open source, it’s not available to inspect and verify.

The encryption used by LastPass protects you if the company is hacked. In theory, a sophisticated man-in-the-middle attack could intercept some encrypted data as it travels between your devices. In both cases, provided you’ve chosen a robust master password, your data would essentially be impossible to decrypt.

Regarding your phone, the answer depends on the age and type of phone, and what settings you’ve selected. Unencrypted Android, Apple and Windows phones may contain data that’s easy to recover after a reset. However, if you have an iPhone running iOS 5 or later or an Android phone running 7.0 (Nougat) or later, your data should be encrypted by default. While encrypted files may remain after a factory reset, they should be almost impossible to access. If even a



↑ Newer phones should be encrypted by default. If you can’t take the chance, shred rather than sell your old phone

remote chance is too much, however, the only guaranteed safe option is to shred the phone rather than selling it. Look for a local shredding service that handles IT equipment.

# Linux on a Chromebox?

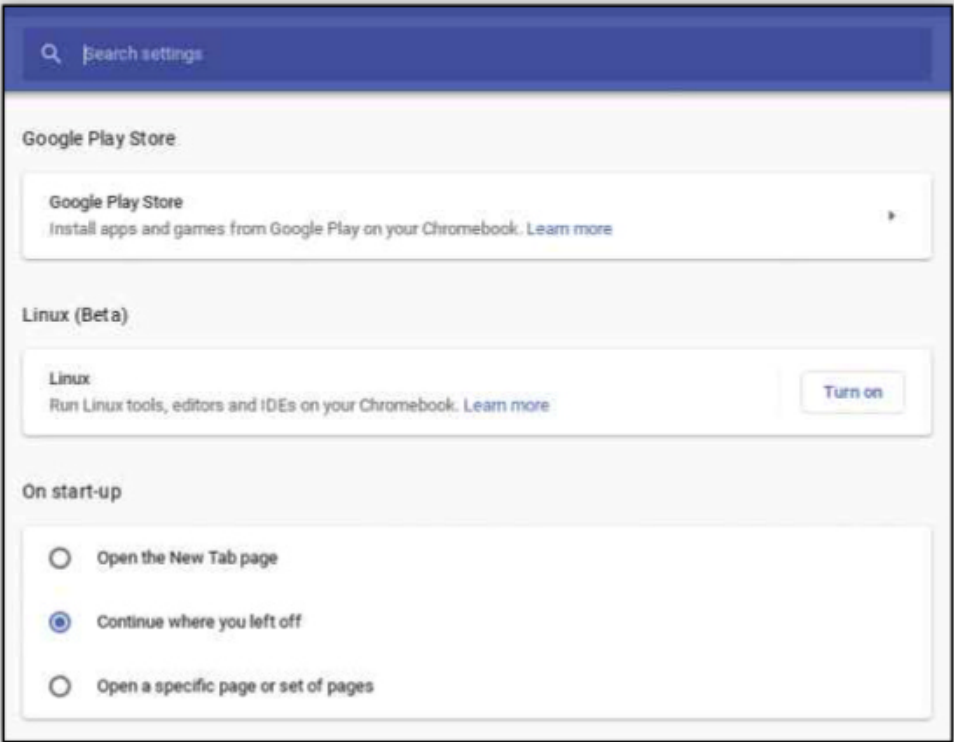
I’ve just bought and set up a barebones mini PC with which I’m very happy, but as I was researching my purchase I saw some Chromebox computers, which are very attractively priced. While I’ve got no interest in using Chrome OS, I wonder if it would be possible to ditch it and install a Linux distribution instead.

I’d be interested to understand how Chrome OS is installed: is it on an SSD, or is it burned permanently into a chip? I looked around the web to see if Linux could be installed instead of Chrome OS, but what I read suggested that this might not be straightforward.

RG Willis

Chromebox PCs are essentially the desktop version of a Chromebook laptop: both run Chrome OS, a lightweight, Linux-based operating system maintained and updated by Google. The operating system is stored on a small SSD, typically with a capacity of around 32GB, the remainder of which is available for local storage; you can’t easily access or replace the OS.

Depending how strictly you interpret the phrase ‘install a Linux distribution’,



there are several possibilities open to you to attempt this. The most straightforward method is to open the Chrome Shell, a Linux Terminal-like environment in which you can access more in-depth settings. On any Chrome OS device, just open the Chrome browser and hit Ctrl-Alt-T.

similar, native support for a Linux environment, although it’s still in beta. It offers a proper Terminal in which you can install and update Linux packages, but speakers, microphones, cameras and USB devices aren’t yet supported, and nor is hardware acceleration.

◀ It’s only in beta, but since version 69 you can run a sandboxed Linux session in Chrome OS

You could install a version of Ubuntu on the Chromebox using Crouton, which sets up Ubuntu to run parallel to Chrome OS, and lets you switch between the two without rebooting. However, from version 69 onwards, Chrome OS has offered



# Not up to date

I hope you can help with an issue I have that's driving me insane. A couple of weeks ago Windows Update failed. I had stopped the service from running by using a batch file that runs at startup and uses 'net stop' to end the bits, dosvc and wuauerv services. I also disabled updates using Ultimate Windows Tweaker and Glary Utilities. I think, between the three methods, something has become corrupted.

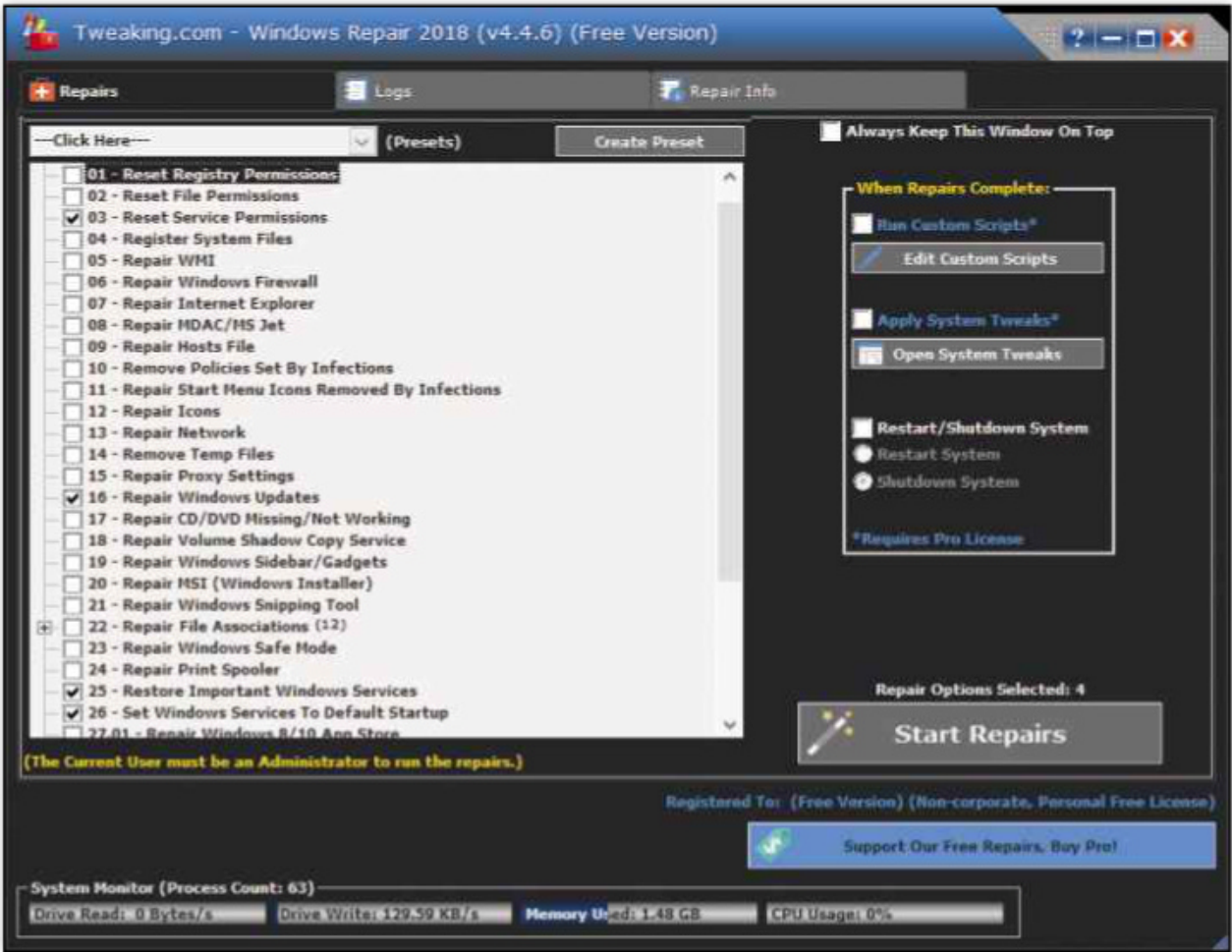
I've tried using 'net start' to restart the above services, which results in "System error 1058 has occurred = The service cannot be started, either because it is disabled or because it has no enabled devices associated with it".

I tried running the Services console, opening the properties for Windows Update and changing its startup type away from Disabled. When I try to save a change to any other service, I get a message that access is denied. I've tried the equivalent with `sc config wuauerv start= auto` from an elevated command prompt, but I get the same error. I checked through the Service Console for service dependencies, but they're all running.

I tried running `sfc /scannow` from an elevated command prompt, then rolling Windows back to a working restore point, neither of which helped. I ran Microsoft's Windows Update troubleshooter, which encountered an unexpected error. Finally, I tried uninstalling the third-party apps, then trying again after turning off Kaspersky Total Security. At this point, I think a Windows reinstall might be my only option, but I'd rather avoid it. Have you any better ideas?

Rob Forsdyke

It sounds as if you were trying to switch off updates in several ways at once. Although that may not have caused the problem, it has probably at least confused things. The results you've listed are consistent with the Windows



There's no need to run all the Tweakings.com repairs

Update service having been disabled, which sounds as though it might be the only underlying problem. Unfortunately, you're being denied access when you try to restart it or change its startup behaviour.

It seems likely that the issue has been caused by one of the third-party apps. Assuming that you tried re-enabling Windows Updates in both before you uninstalled them, you may need to try fixing things with the Tweakings.com Windows Repair tool. However, before you do anything further, take a full backup, if you didn't already, then re-run the Windows Update troubleshooter, click Advanced, and choose Run as Administrator.

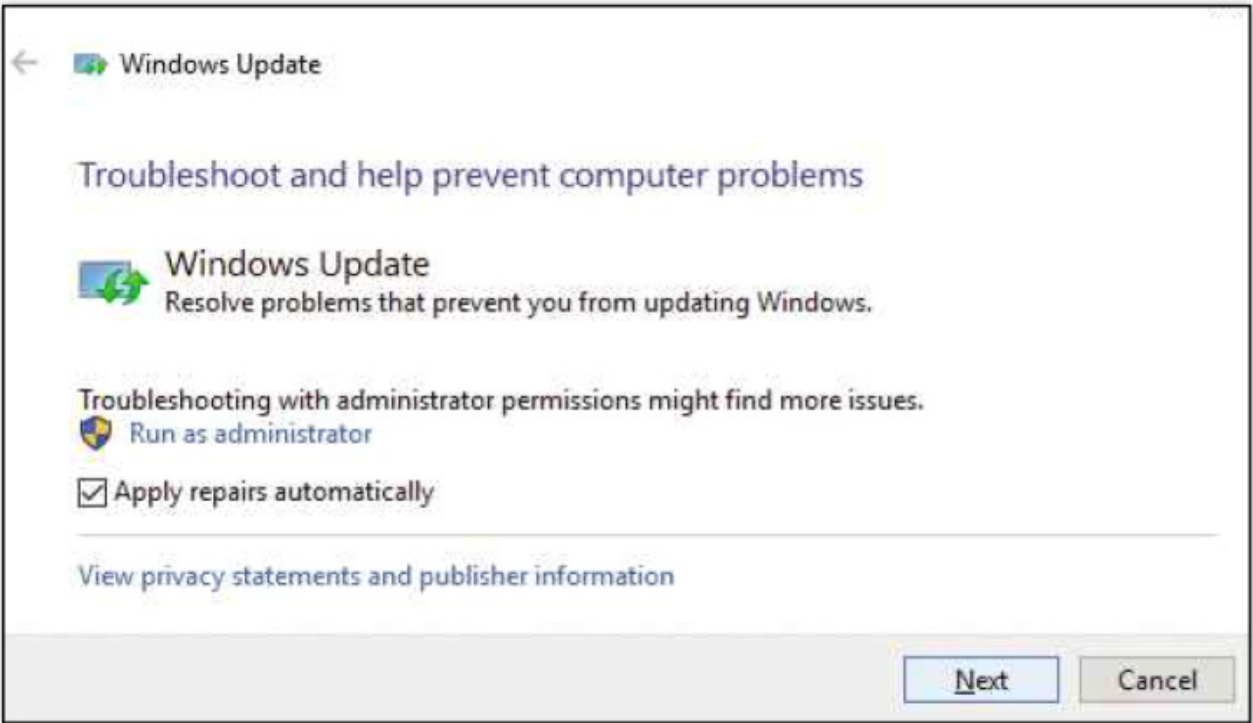
Assuming that doesn't work, download the Tweakings.com tool from [tinyurl.com/](http://tinyurl.com/)

[378helpfile1](#), run the installer, and run the program when it's installed. Click Reboot To Safe Mode, agree to reboot the computer, then when the computer reboots in Safe Mode run the Tweakings.com tool again. Click Jump To Repairs, click Open Repairs, then in the list that appears untick All Repairs and retick 03 Reset Service Permissions, 16 Repair Windows Updates, 25 Restore Important Windows Services and 26 Set Windows Services To Default Startup.

Finally, click Start Repairs and let it finish; it should take less than a couple of minutes. Reboot when prompted, open the Start menu, type update, run Check for updates and click the Check for updates button. The update issue should be fixed.

This repair will temporarily block the Microsoft Management Console, which means you'll see the error 'An administrator has blocked you from running this app' if you try to open either the Services or Computer Management consoles. This should clear 15 minutes or so after you've rebooted from Safe Mode, once the computer has finished processing the various changes and repairs.

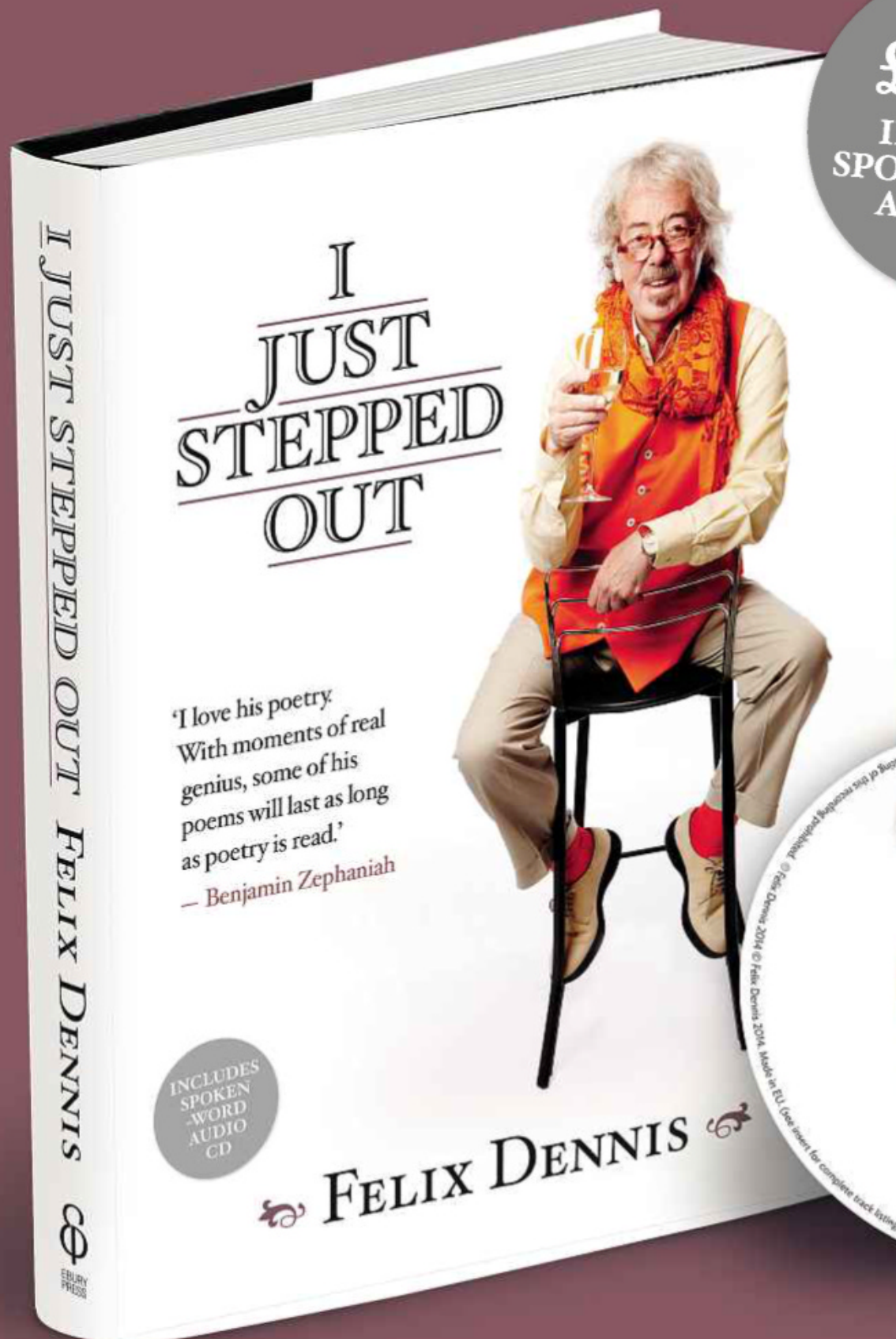
If Windows Update still isn't working, a reinstall may be for the best. Thanks to an improved process, which can preserve your apps and files, it's not quite the nightmare it once was. To start, click the Update Now button at [tinyurl.com/378helpfile2](http://tinyurl.com/378helpfile2) and the Windows 10 Update Assistant will default to upgrading your existing installation, preserving your data. You will have to spend a while restoring all your Windows settings, but otherwise the impact is surprisingly minor. ☑



If a troubleshooter doesn't work, try running it again as administrator



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# Advanced Projects

**Clive Webster** has been tinkering with computers ever since Windows 98 forced him to manually install his drivers

[clive@computershopper.co.uk](mailto:clive@computershopper.co.uk)



## Build your own AI

The rise of the robots might still be a few years off, but we're on the cusp of the AI revolution. **Clive Webster** shows you how to build your own personal AI for £42

**SMART SPEAKERS AND** AI devices are the latest cool gadgets, but we're already hearing of some gadgets spying on its users by 'always listening' (see 'Talk To Me' on page 78). There's no doubt as to how useful these voice-controlled assistants can be, so the question then becomes, 'how can you trust them?'

The answer is easy: rather than trust a huge multinational company to make your AI assistant, you make it yourself. Google's AIY Voice kit allows you to do just that, and as it's designed for developers and makers, you can monitor its behaviour and alter how it works.



**POSSIBLY THE TRICKIEST** step in building your own AI – at least without our help – is where to buy the kit. Since Google launched its AIY kits, they've had a habit of selling out within hours and being out of stock for months. Thankfully, a reliable supplier has emerged in the form of Mouser Electronics. Go to [www.mouser.co.uk](http://www.mouser.co.uk) and search for AIY Voice. The kit costs £42 and shipping is free.

Inside the kit is everything you need to make an AI kit, including a Raspberry Pi Zero WH and the cute cardboard housing. Better yet, the build doesn't require a soldering iron to connect the few wires. However, you need a 2.1A power adaptor (but not the Micro USB cable), a microSD-to-SD adaptor and a small flat-head screwdriver, the sort you get in posh Christmas crackers.

On opening the AIY Voice box, you'll see two pieces of cardboard bundled together and the layout of components. But the first job is to download the latest version of the AIY Voice operating system (it's a pre-loaded and modified version of the Raspberry Pi's standard Raspbian OS) from [tinyurl.com/378projects1](http://tinyurl.com/378projects1). This is a large file, roughly 1.2GB, so start this download before building the hardware.

There are no instructions as to how to build the hardware in the box, but there is a subtle message on the inner lid that points you to [aiyprojects.withgoogle.com/voice](http://aiyprojects.withgoogle.com/voice). While the instructions are pretty clear, there are a couple of points that we cannot stress strongly enough.

The first relates to the inner 'cage' made of the complex, flat piece of cardboard. As the images on these pages show, you essentially fold this piece of cardboard back on itself and then pinch in the two wings to make the curious structure that holds the Pi and the speaker. However, it's possible to fold the cardboard the wrong way.

## HELP CENTRE

To avoid an error, and having to dismantle the cage, note that the two long slots are off-centre. One slot is much nearer the edge of the cardboard than the other, and this slot must be the left-most at all times. When this piece of cardboard is flat, the portion with the two slots is uppermost, and you then fold this section backwards via the two creases. Then pinch the two sides forwards, and fold the slotted section forwards and under, so that the two tabs slide into the two slots.

Once the cage is prepared, you can assemble the Pi and the AIY Voice HAT. Holding the Pi with its GPIO header pins to the left, push the two standoffs

➔ The AIY Voice Kit costs just £42 and includes everything you need to get started



↑ The components are laid out attractively in their box

into the two holes on the right of the circuit board. You need to be somewhat firm to make them snap into place. Then take the AIY Voice HAT and slide it on to the GPIO pins and the standoffs. You should end up with a very solid tech sandwich. Then slide the Pi-and-HAT combo into the jaws of the cage. You'll find that the cardboard uprights slide quite precisely between some of the components on the HAT's circuit board.

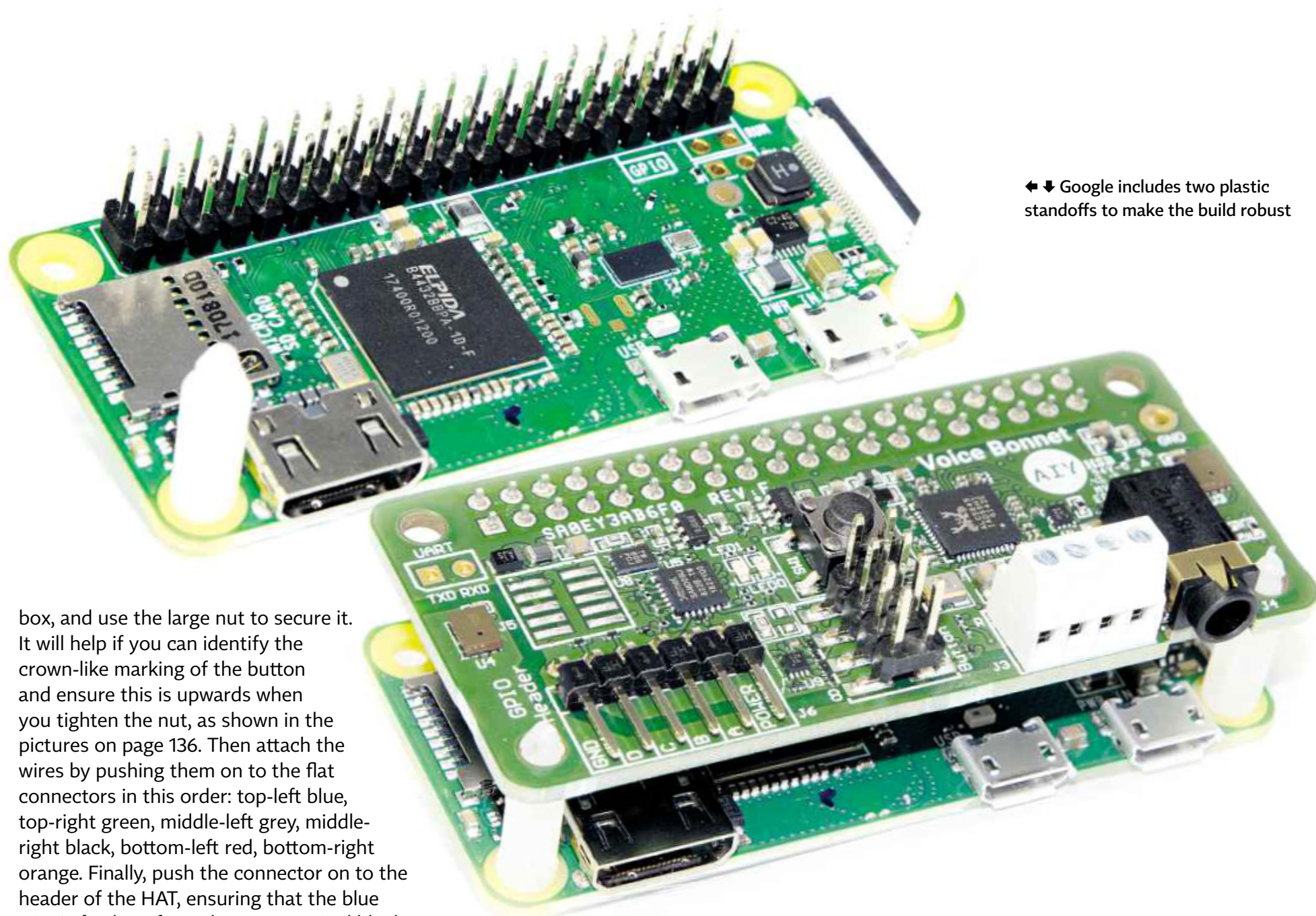
The next step is to shove the speaker into the large slot at the 'back' of the cage; it's a tight fit, so be firm. Put the speaker in with its two wires facing upward. Once in place, take your small flathead screwdriver and loosen the two left-most terminals of the grey block (the two furthest from the audio jack). Slide the red wire into the terminal furthest from the audio jack and the black wire in the next terminal, and then screw both down tightly.

You can put your assembled internals to one side and pick up the other piece of cardboard. This is a pretty simple box, but Google has been clever in how this goes together, too. Fold flap A to 90 degrees, then fold down flaps B and C, and then fold down flap D; press the tab of flap D down a little to slide it home and you'll have created a sturdy box bottom very simply. Take your assembled cage and slide this into the box with the speaker facing towards the side with seven holes.

The last job is to install and wire up the big arcade-style button. Push the button in from the 'outside' of the lid of the







◀ ▶ Google includes two plastic standoffs to make the build robust

box, and use the large nut to secure it. It will help if you can identify the crown-like marking of the button and ensure this is upwards when you tighten the nut, as shown in the pictures on page 136. Then attach the wires by pushing them on to the flat connectors in this order: top-left blue, top-right green, middle-left grey, middle-right black, bottom-left red, bottom-right orange. Finally, push the connector on to the header of the HAT, ensuring that the blue wire is furthest from the grey terminal block. Then shut the lid, using the tab to secure it.

## GETTING ASSISTANTS

By now, the AIY operating system should have downloaded. Unzip the Disc Image File (.img) file and save it somewhere memorable. Next, take the microSD card from its case and insert it into your computer via your adaptor. Cancel all the various warnings about unformatted disks. Use a tool such as Rufus (see [rufus.ie](http://rufus.ie)) to 'burn' the .img file to microSD card, agreeing to reformat the two partitions.

Once Rufus has done its magic, you'll need to open the Boot partition and create a text file called `wpa_supplicant`. Enter the following, replacing <SSID> and <PASSWORD> with your own Wi-Fi name and password.

```
ctrl_interface=DIR=/
var/run/wpa_supplicant
GROUP=netdev
update_config=1
country=GB

network={
    ssid="<SSID>"
    psk="<PASSWORD>"
    key_mgmt=WPA-PSK
}
```

Save the file and then open the View menu of Explorer; tick the box to show file name extensions. Change the file extension from `wpa_supplicant.txt` to **`wpa_supplicant.conf`** (ignore the warning) and then untick the box to hide the filename extensions again.

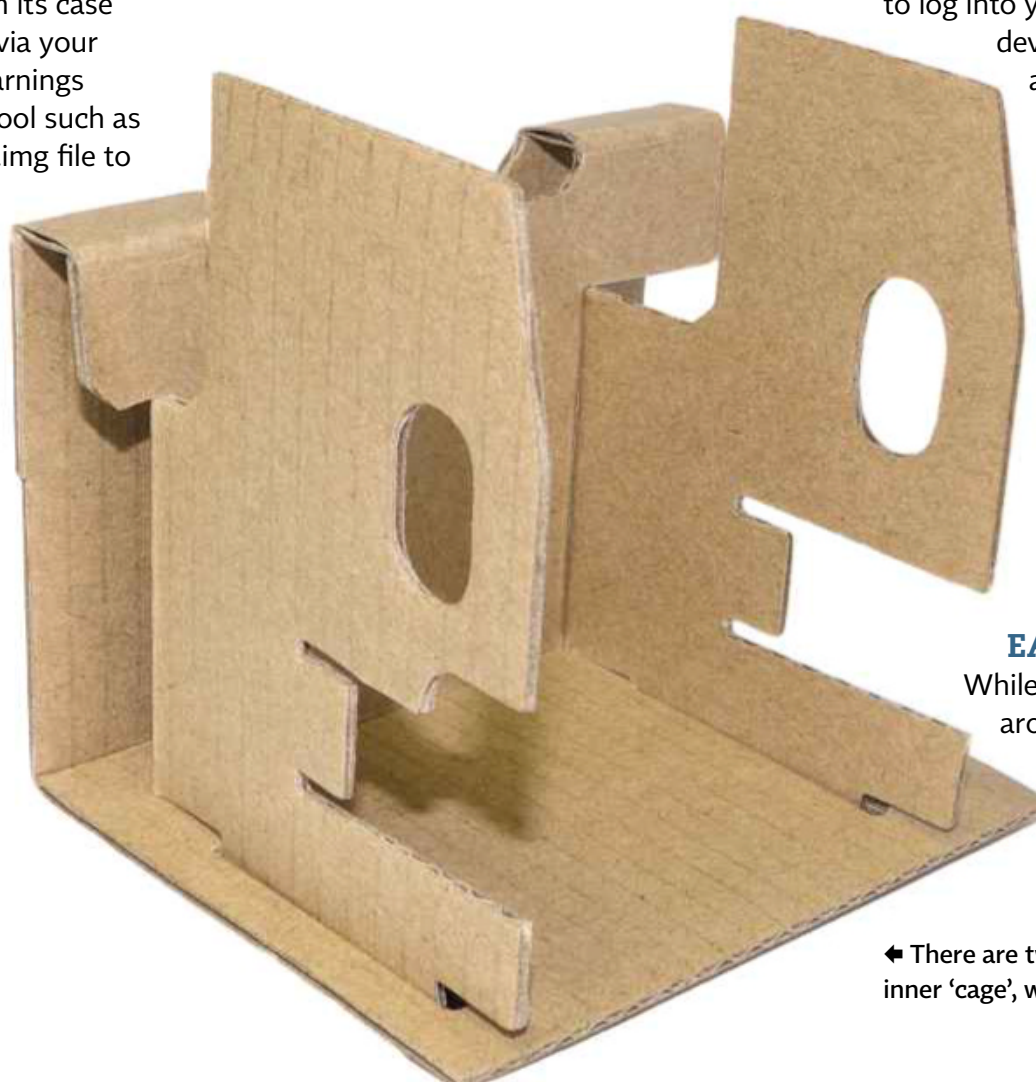
Then remove the microSD card, insert it into the Pi and power it up.

The `wpa_supplicant` trick should mean that the Pi automatically connects to your Wi-Fi network, so the next job is to find its IP address. We find the easiest way to do this is to log into your Wi-Fi router and look up the device (called `raspberrypi`). The IP address will look something like 192.168.1.100, so note this down. Then use an SSH tool such as PuTTY (see [putty.org](http://putty.org)) to connect remotely to the AIY Pi. Log in with the standard username and password of pi and raspberry. If you plan on using the Pi for any length of time, change this default password using the command **`passwd`**. Update the system by entering **`sudo apt-get update && apt-get -y upgrade`** and hitting Enter.

## EAR, ROBOT

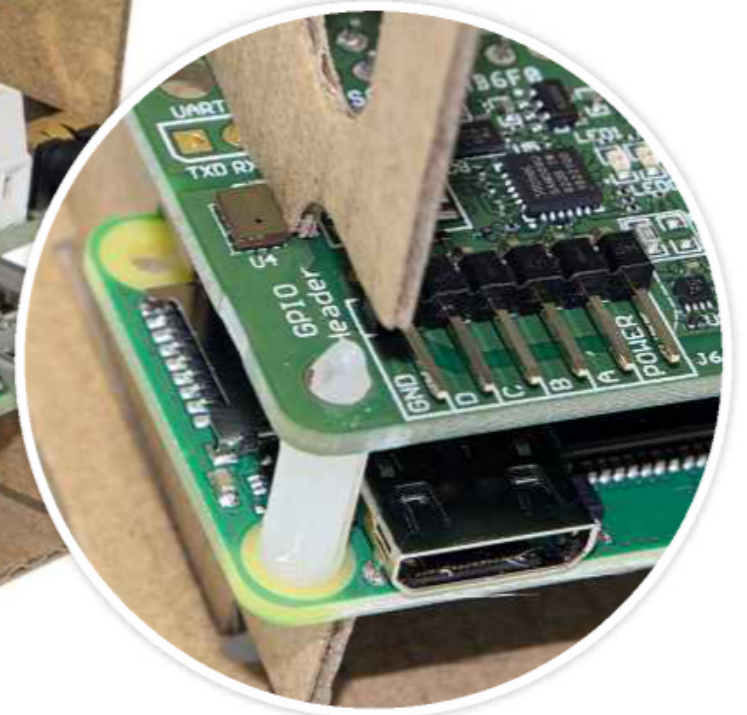
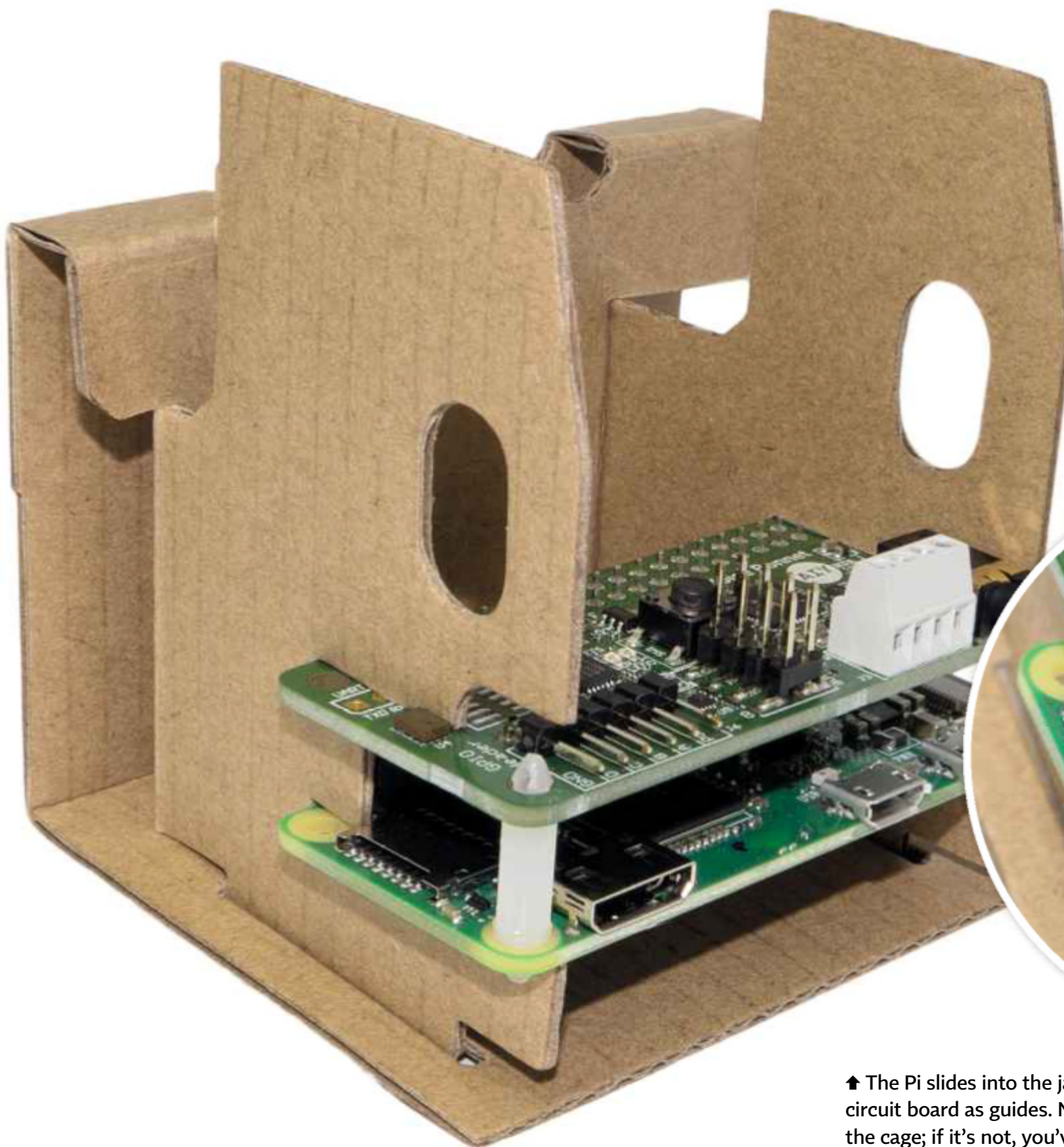
While there is another AIY kit based around vision (leading to the unavoidable 'Eye, Robot' crosshead if we ever cover it), this kit is all about voice interactions and machine

◀ ▶ There are two elements to the casing: this is the inner 'cage', which holds the Pi and the speaker





Rather than having to read *Alice in Wonderland* to your AIY Voice kit for it to understand what you're saying, it should comprehend you immediately



↑ The Pi slides into the jaws of the cage using elements of the HAT circuit board as guides. Note that the Pi is almost flush with the 'floor' of the cage; if it's not, you've constructed the cage the wrong way round

learning of natural language. So rather than having to read half of *Alice in Wonderland* to your fully operational AIY Voice kit for it to understand what you're saying, it should comprehend you immediately.

Or almost immediately, because you still need to set up the software. The first step is testing that the microphone and speaker work. In the PuTTY SSH window, enter `/home/pi/AIY-projects-python/checkpoints/check_audio.py`, press Enter and follow the instructions. If the volume is too loud, enter `alsamix` and use the arrow keys to lower the volume; press Escape and re-run the `check_audio.py` script.

Now you need to switch to a web browser and head to the Google Cloud Platform, [console.cloud.google.com](https://console.cloud.google.com). Log in using your Google account (or create one) and click on the Select a project menu at the top. Select New Project, and then enter a name before clicking Create. Once the Google spinning thing has finished, open the sidebar menu by clicking on

the three horizontal lines and then choosing Library from the APIs & Services menu.

On the Libraries screen, search for Google Assistant API, click the result and then Enable. After a few seconds an

Overview screen will load; click the Create Credentials button. Choose Google Assistant API from the drop-down menu, then Other UI (for example, Windows, CLI tool) from the drop-down menu that appears. Next, select User data under the What data will you be accessing? section. Then click the blue What credentials do I need? button. This will produce a popup called Set up OAuth consent screen; click Set up Consent Screen. This is a departure from Google's instructions, which were out of date at the time of writing.

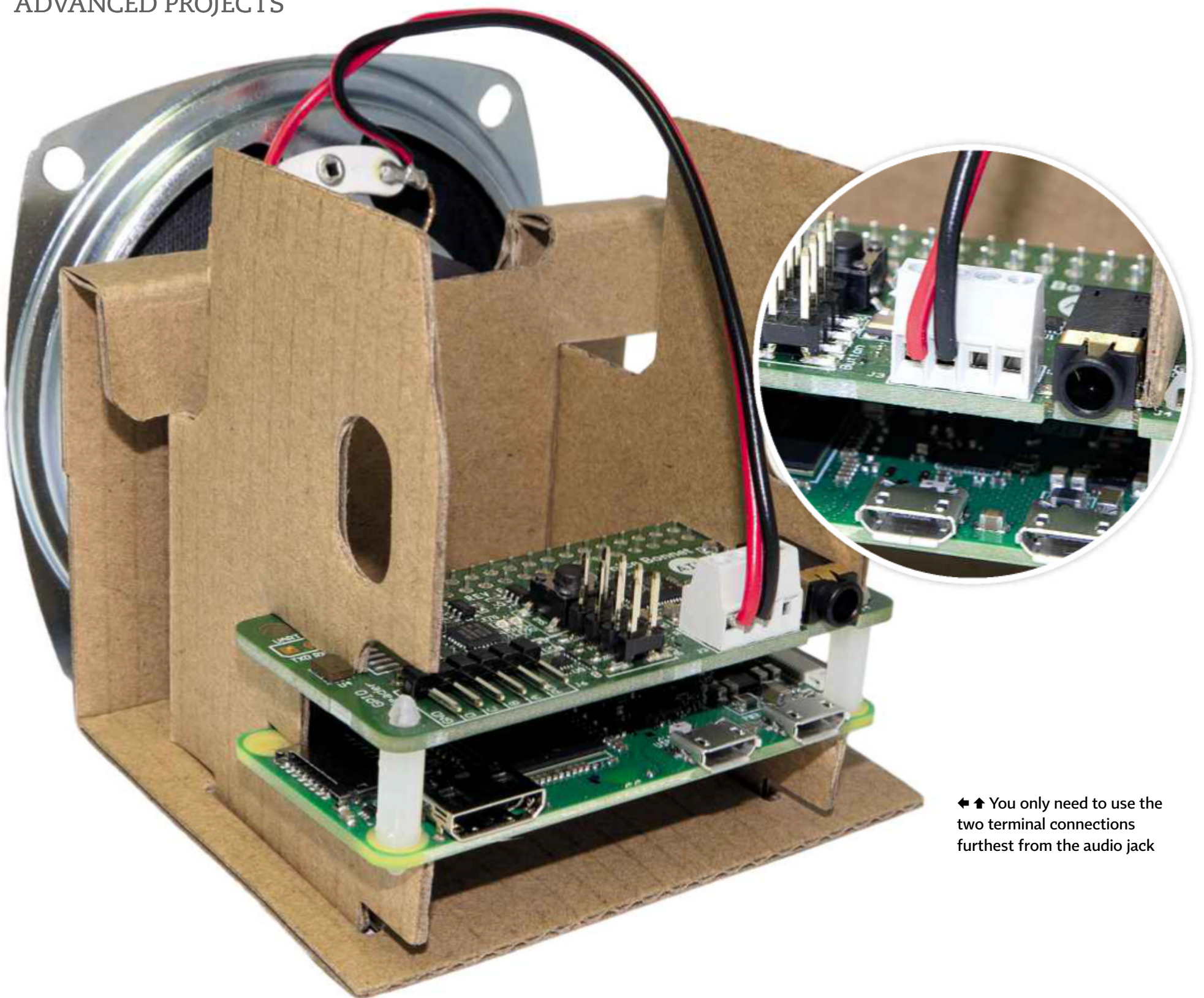
### WHAT'S IN A NAME?

The only piece of information to enter is the Application name, which is the public name of the project; we kept this the same as our project name, VoiceProj1. Once saved, you can return to the Credentials wizard, which ought to have opened, possibly in a separate browser tab. On this screen, again enter your project name, and then click the blue Create OAuth client ID button. This will generate a long string of characters, which is your Client ID. Click the blue Download button and a JSON file (which stands for JavaScript Object Notation, just



➔ The design of the box is just as neat as the cage





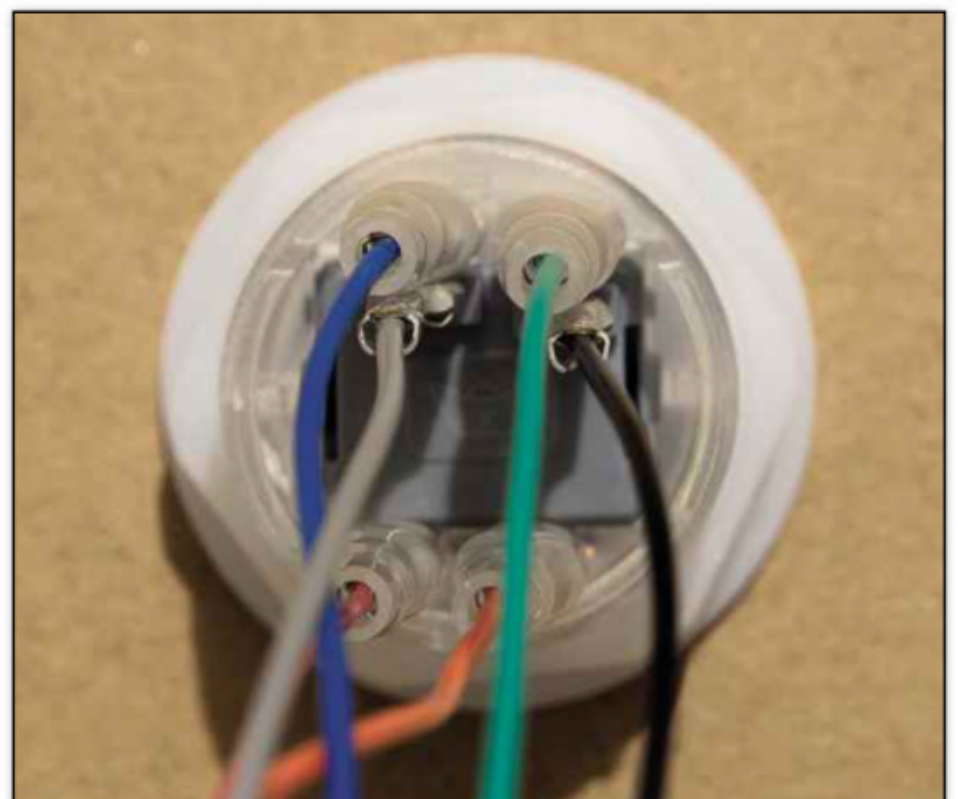
⬅ ➡ You only need to use the two terminal connections furthest from the audio jack

in case you're ever on a very tech-heavy quiz show) called `client_id.json` will download.

Open this JSON file by right-clicking, choosing Open with, then selecting Notepad from the list. Once open, you need to select all the text (Ctrl-A) and copy it (Ctrl-C). Then

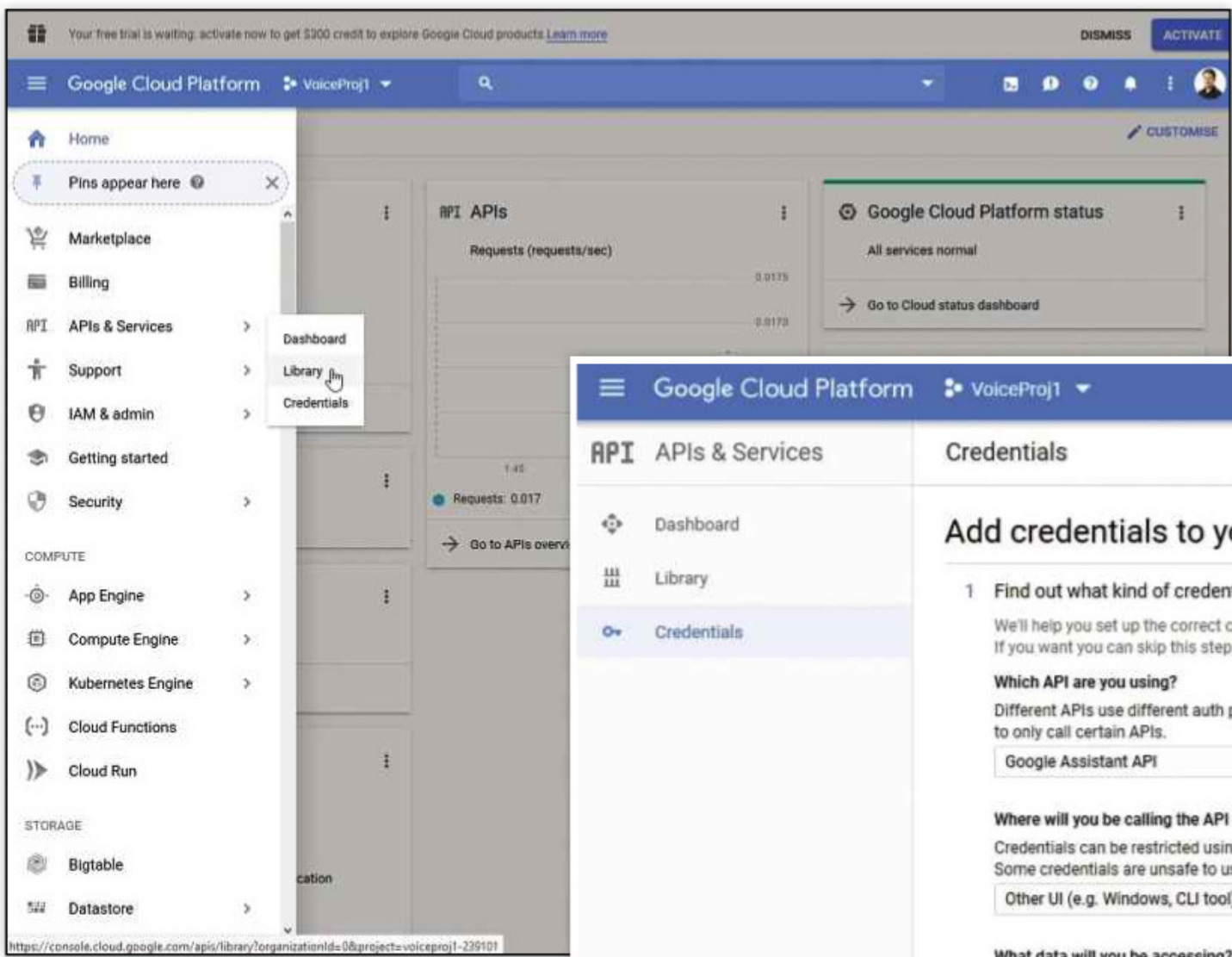
switch to the PuTTY SSH window and enter **nano assistant.json**, which opens a text file called `assistant.json` in the Nano text editor. Now right-click in the PuTTY window to paste in the contents of the JSON file. Press Ctrl-X followed by Enter to exit and save the file.

You've now almost set up your own infallible font of wisdom. Move to the demo folder by typing `cd ~/AIY-projects-python/src/examples/`. Then type **voice/assistant\_grpc\_demo.py** and hit Enter. Wait a few seconds and you'll be asked



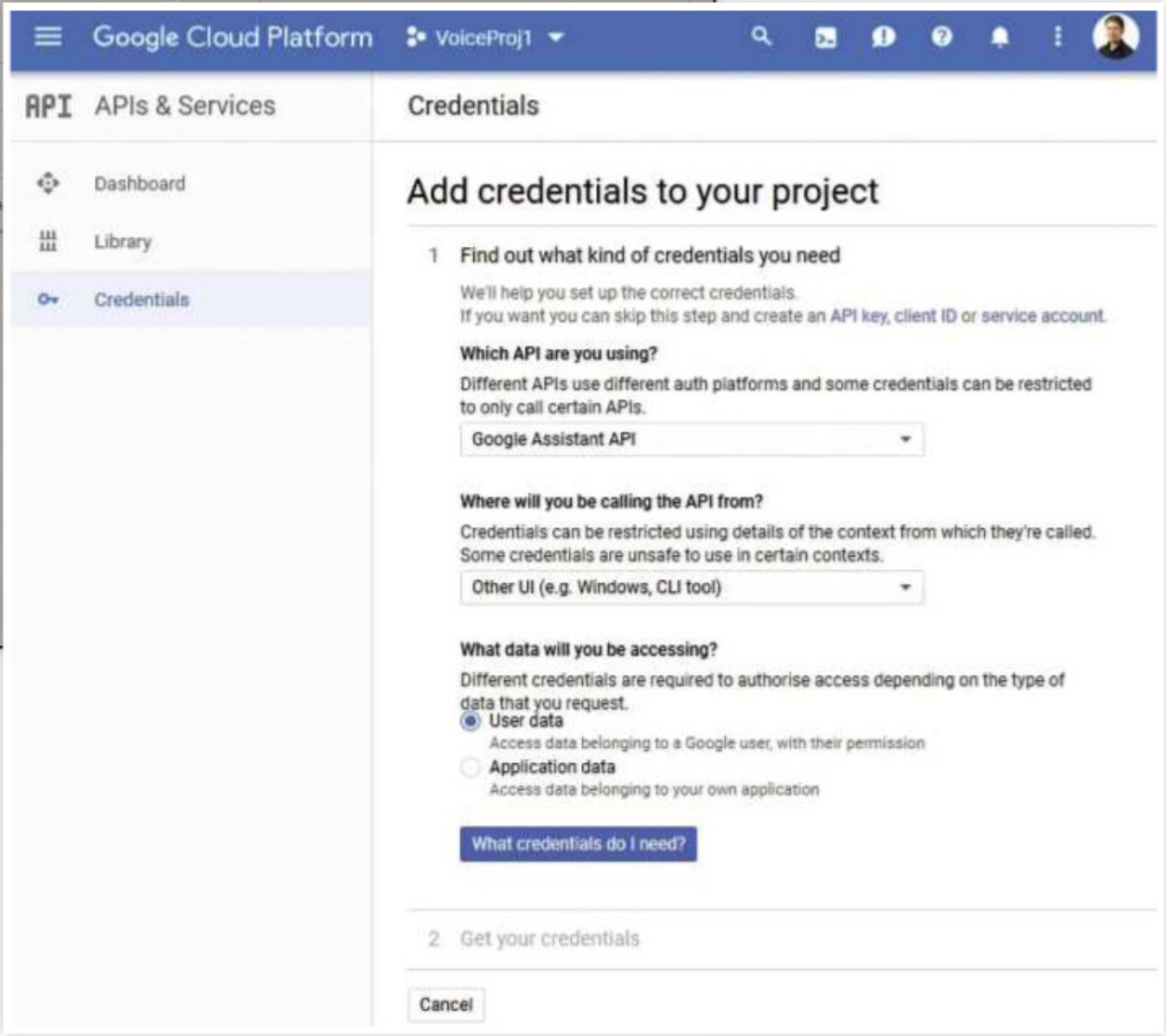
⬆ You must attach the six wires in this order; use the crown logo to check against this picture





◀ Setting up the Google Cloud Service is quite fiddly

⬇ Getting your Credentials information is the trickiest part of the process, not least because Google’s advice was out of date at the time of writing




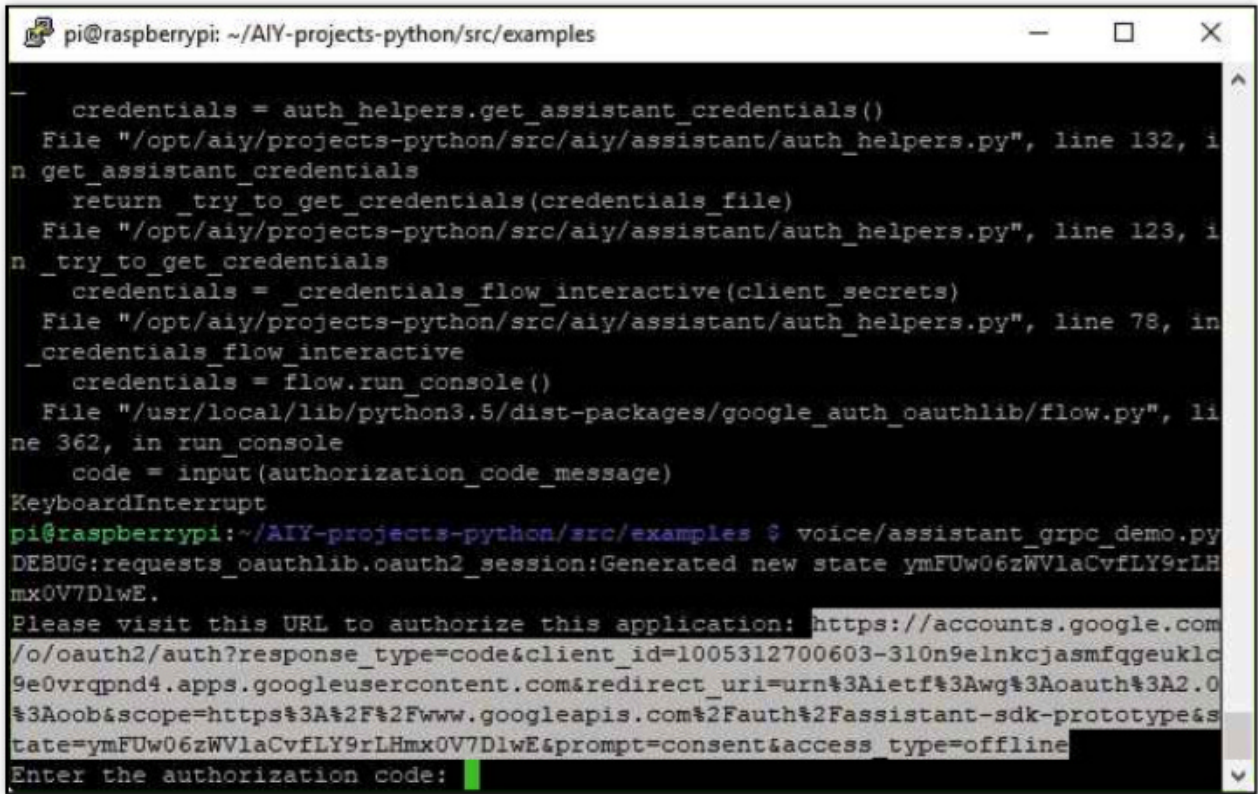
for the authorisation code, which is generated once you enter the huge URL into a web browser.

You don’t need to copy the URL manually, however, as just highlighting the text automatically copies it to your clipboard. You can then switch to a web browser, paste the copied URL into the address bar and follow the instructions to link the AIY kit to your Google account. Once the authentication code has been generated, you can paste it back into PuTTY by clicking the highlight button (the two overlapping squares) and right-clicking the PuTTY window. Hit Enter and let the code work

through; after a few seconds you should see the button on your AIY kit light up, with a message on the PuTTY screen to press the button to start a conversation.

Once you press the button, you’ll see the message in PuTTY update to INFO:root:Converstation started. Ask your AIY kit a question and it will answer, while the PuTTY screen will show any AI or learning information required. It’s fascinating to watch as the AI tries to rework words that it didn’t quite understand in order to form a sensible question to answer. And some questions throw up interesting responses: ‘Is this parrot dead?’ for example, or requesting the AIY kit to ‘beatbox’. Some answers aren’t so brilliant, but the responses come pretty quickly.

A question-and-answer box is the most basic use for the kit, especially as you have to press the button to ask the question. You can play with activation phrases, or use the exposed six GPIO pins to interact with the physical world. 



⬆ You need to copy and paste this huge URL into a web browser to authenticate the AIY kit. Thankfully just highlighting the URL in PuTTY automatically copies it to your clipboard

NEXT MONTH

USE WORD LIKE A PRO

Microsoft Word might be widely used, but is it well used? We show you some power-user tricks



# Zygote

**Zygote** has an important message for the world. Unfortunately, BT is broadcasting it, so the world will just have to wait for the system to reboot before receiving it

## SUCKERS

Armed police were called to a reported burglary near Portland, Oregon, after a mystery intruder was heard breathing heavily and ransacking a bathroom. With guns drawn and an attack dog straining at the leash, the cops broke down the door to arrest the culprit, which turned out to be a Roomba intelligent vacuum cleaner.

Zygote suspects the robot was simply emulating human behaviour, and wanted to score some Angel Dust and feed its addiction to snorting the white powder known as Shake n' Vac.

## TOWER OF POWER

Since the dawn of the Age of Electricity, landmark buildings have been used as a platform to display important illuminated messages. For example, when in London, Zygote always takes notice of the giant lettering beamed by red lamps from the top of the BT Tower, knowing that whatever is displayed must be of vital importance in terms of essential public information, as well as being indicative of BT's own priorities.

Which is why Zygote is duty-bound to report the following message beamed from the BT Tower over our capital from the summit of its enormous erection, as follows: "Choose operating system to start or press TAB to select a tool, use arrow keys to highlight your choice and then press ENTER."

Presumably this can only refer to BT's corporate status regarding Brexit, and as such is an important lesson to us all.

## GANG WAY

The Gangs Violence Matrix is a confidential database set up by Her Majesty's Metropolitan Police force. As well as holding comprehensive details about convicted felons, it also ranks an individual's likelihood of being involved in future gang-related violence. So it came as

something of a surprise when detailed screenshots of the Violence Matrix appeared all over Snapchat and other social media.

According to the Information Commissioner's Office (ICO), these "multiple and serious" database breaches have been traced to offices at Newham Council, and they include date-tagged identities, addresses, ethnicity, mugshots, nicknames, firearms offences, knife crimes and alleged associations with named gangs.

This is very bad, but even worse is the fact that rival gang members have gained access to the leaked data. The ICO has also declared that the risks "should have been obvious", and that the number of identities leaked from the Gangs Violence Matrix runs into the hundreds.

## FRENCH KISS

*C'est très bien* to see the French have taken a lead when it comes to spotting offensive and illegal content on the web. According to the EU Internet Referral Unit, service providers in France are now legally obliged to remove material that has been reported by concerned citizens as terrorist content. What's more, they have to take it down within the hour, which is great news.

And in case you're wondering what sort of disgusting and

dangerous material has already been reported, Zygote can reveal that the list of horrors includes *Alice in Wonderland*, the greatest hits of The Grateful Dead and *The Tale of Peter Rabbit*.

So we can all sleep easier in our beds as a result, *n'est-ce pas?*

## CHIC CAR GO

Car2Go is a very popular smartphone app for drivers in the Chicago area. Very popular with crooks, that is.

The original idea was to click on the app, prove your identity and rent a luxury Mercedes Benz by the hour. But as it turns out in practice, organised gangs have used fake credit card details to register as users, and so far as many as 100 high-end Mercs have gone missing.

The developers, Share Now, have objected to media reports that their app has been 'hacked', insisting that no legitimate customer data has been compromised. What has actually happened is far more enterprising, which is that most of the missing limos have been used as getaway vehicles in a city-wide crime spree. So that's all right, then.

## PING PONG

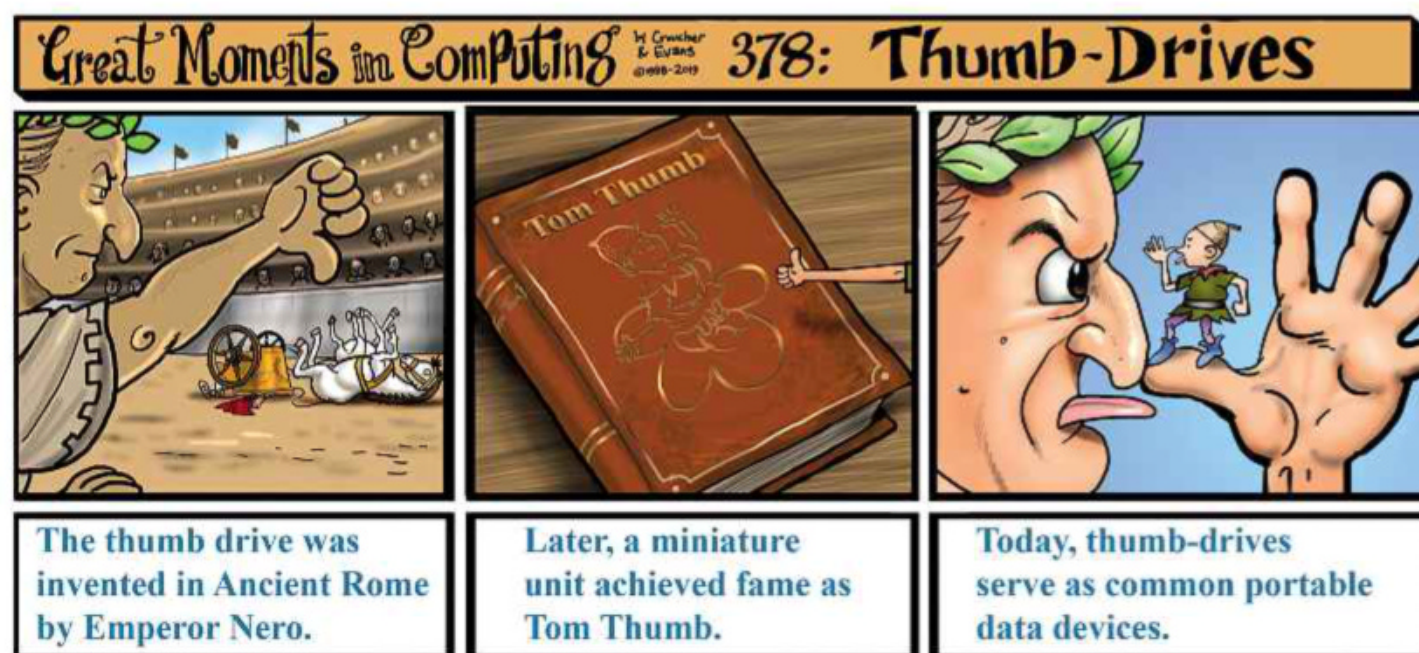
It's official, computer games players stink. A game called Yu-Gi-Oh is one of the highest-

grossing media franchises of all time, with legions of players battling for hours in stadium tournaments. The problem is that many of these fans are too engrossed in their lengthy and frantic gameplay to bother with personal hygiene.

Which is why the official Yu-Gi-Oh tournament rules have just been updated to include some timely advice, as follows: "You are expected to be clean when you enter the tournament. Neglecting to wash contributes to an unpleasant atmosphere at the event, as the tournament can be crowded and the day can be long. Persons who neglect self-care to the point that they are negatively impacting the tournament will be asked to correct the issue."

Just to make sure there is no misunderstanding, the rules also state, "If you or your clothing is bad-smelling, you can be penalised."

Not wanting to miss out on any opportunity to make even more money from their players, the game owners have released their own branded soap, shower gel and deodorant, originally costing \$10. But fans have now taken to trading 'rare' editions of these snappily titled Yu-Gi-Oh Dirt-Dueller packs at up to five times their face value. Which is not to be sniffed at. 🐾





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